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THE TRANSMISSION OF POWER TO LONG DISTANCES.

WE have in our two last numbers of the ELECTRICAL REVIEW published interesting and critical articles on the Miesbach-Munich experiments conducted by M. Marcel Deprez on the transmission of power to long distances on an ordinary telegraph wire. Apparently, the result of M. Deprez's very important work has been badly described, or it has been misunderstood. Some time since, in an article entitled "Half Truths and Whole Truths," we drew attention to the confusion which might be derived from a misunderstanding of the terms electrical horse-power and actual or indicated horse-power developed in an engine. It would seem that the same confusion exists with respect to M. Deprez's experiments. In a long letter to our contemporary, *La Lumière Electrique*, this well-known French electrician takes great pains to explain exactly what the results of his work amount to. He says:—

"If the result is measured electrically it is well known that the economic result of an electric receiver may vary from zero to a value approaching unity according to the charge of the brake applied to this receiver, whereas the work absolutely obtained commences at zero when the charge of the brake reduces the motor to rest, and then proceeds towards the maximum in proportion as the brake is loosened, and returns to zero when the brake is completely loosened. Also when the two machines (the generator and the receiver) are identical, and the line is well insulated, the economic result (allowance being made for friction of the axles and the brushes, the resistance of the air, and the vibrations of the two machines) is according to the ratio of speed of the two machines, whether the machines be close together or far apart.

"If, however, by the word result we wish to designate the ratio between the work of the receiver, measured by the brake, and the work of the generator, measured by the dynamometer, subtracting all the losses of power due to friction, to the vibrations, and even to the very slight derivations of the current along the line, the question is changed, and the *ratio of the speeds is no longer sufficient.*"

It is not a little curious to note that the loss of current on the line between Miesbach and Munich, according to M. Deprez, did not exceed two per cent., or, in other words, if the intensity of the current at the former place be represented by 1, that at Munich was 0·98, or more. We can scarcely think, however, that this result can be anywhere near the truth, if it is fair to base our ideas upon tests of English telegraph lines. M. Deprez brings forward three points upon which he feels it his duty to enlighten those who are impartially interested in his experiments. These points are:—

(1) The value of the actual work transmitted to Munich and measured by the brake.

(2) The economic industrial result (which must not be confounded with the electrical result, the value of which is the ratio of the speeds), *i.e.*, the ratio of the work absorbed at Miesbach by the generating machine and measured by the dynamometer, to the work absorbed at Munich and measured by the brake;

(3) The loss of current at the posts and the influence of the weather on this loss.

As far as the first question is concerned, he quotes the experiment made by M. Sarcia, on the 26th September, which enabled him to read from the brake an effective work of 38 kilogrammetres per second, the speed of the receiver being 1,500 revolutions per minute, and that of the generator, situated at Miesbach, 2,200 revolutions. The electrical result was, therefore,

$$\frac{1,500}{2,200} = 0{\cdot}68.$$

But, of course, says M. Deprez, the industrial result, *i.e.*, the ratio of the effective work (measured on the brake at Munich) to the work expended (measured on the dynamometer at Miesbach) was below this amount.

M. Deprez then goes on to state that when he gave to the Academy of Sciences the note which appeared in *La Lumière Electrique*, the electro-technical committee had not arrived at any estimate of the result, and therefore not having a dynamometer at his disposal, he could only give the electrical result, measured by the ratio of the speeds; and he considers his explanation sufficiently clear to render any misunderstanding impossible.

He then informs his readers that the machines at his command were somewhat defective in consequence of having been damaged and indifferently repaired; but that in spite of this, they were able to be used under these unfavourable conditions for a period long enough to enable the technical committee to take sufficiently accurate measurements, the generator making 1,600 revolutions and the receiver 750. The effective work was, therefore, scarcely 20 kilogrammetres per second, and the work measured at Miesbach with the Hefner-Alteneck dynamometer was about one horse-power. The industrial result was, therefore, about 25 per cent. It was then desired to increase the actual work of the receiver, and without altering the charge of the brake the speed of the generator was increased to 2,000 revolutions per minute; the speed of the receiver naturally increased up to 1,200 revolutions per minute (corresponding to 30 kilogrammetres of effective work per second), when one of the brushes, being badly fixed, became suddenly detached and fell down. This last sudden breaking off of the current happening when the electromotive force of the generator exceeded 2,000 volts., completed the destruction of the insulation of the rings, and from that moment the receiver could not even turn alone.

From the figures communicated to me verbally by the members of the committee, says M. Deprez, it follows that the electrical result when measured varied from 50 to beyond 60 per cent., whereas the industrial result varied from 25 per cent. in the first experiment (the generator turning at 1,600 revolutions) to more than 35 per cent. in the second (the generator turning at 2,000 revolutions).

This is practically equal to half the electrical result. The electrical result was measured by taking directly the electromotive force of the machines and the intensity of the current at Miesbach and at Munich, and this value was found

to agree to all intents with that obtained from the ratio of the speeds. M. Deprez, therefore, ignores the loss along the line.

Whatever may be thought of M. Deprez's experiments and the critical remarks to which they have been subjected, he has decidedly taken the lead in concentrating public attention on the subject of transmitting power to long distances. Although the subject has recently been brought forward in such a way as to lead many to believe that this able French engineer was the originator of transmitting motive-power by electricity, the experiments of Siemens, Werdermann, Fontaine, and others in past years should not be overlooked. We ourselves remember, shortly after the first Gramme machines were constructed in England, a long series of experiments made by Mr. Werdermann on this very subject. He may probably still have the data of the results obtained, but the tests were made over very short distances. But to M. Marcel Deprez belongs the honour, not of being the original instigator of these important researches, but of having carried out the ideas of others on a large enough scale on which to form a commercial basis.

We heartily wish that exhaustive trials on the electrical transmission of power may shortly be made in England, and that the electrical result, and the result in actual work produced, may not be so intimately mixed up as to create such a misunderstanding as has apparently been the case over the Miesbach-Munich experiments.

Since writing these lines we have received a communication from M. Hospitalier on the same subject, which will be found in our other columns.

BROCKIE'S ELECTRIC ARC LAMP.

Amongst the many successful inventors of electric arc lamps Mr. Brockie has gained a high position. He struck out a new path for himself in his first lamp, which our readers well know is regulated by periodical commutation by means of a circuit separate and independent of that used for the main current. Therefore we may assume that any further outcome of Mr. Brockie's inventive powers will interest electrical engineers to a more than ordinary degree.

The subject of this article appears likely to prove as great a success in its action as did the inventor's original lamp, for although since that time arc lamps have been brought forward in such numbers, and in some instances possessed of such simplicity that it seems doubtful whether any better devices could be imagined, yet Mr. Brockie's present invention is apparently possessed of such good qualities that we should not be surprised to find it take as favourable a place in public estimation as any now in use.

The description of this simple and ingenious lamp may best be put forward in the words of the inventor's specification :—

"Fig. 1 is a view of the regulating escapement of an electric arc lamp constructed according to my invention ; fig. 2 shows a complete lamp with my improvements applied, and fig. 3 shows a regulating motor for electric lamps constructed according to my invention. Similar letters of reference refer to like parts in all the figures.

"In all electric arc lamps hitherto constructed which regulate by the action of a magnet or solenoid either in the main circuit or in a shunt across the arc, or by a combination of both, the regulating armature, or core, bears a certain and definite mechanical relation to the releasing or feeding mechanism (usually a brake or clutching device) the armature being jointed directly or by levers to the disengaging brake or clutch. Now, I propose to do away with the definite or direct connection, and to gear the regulating armature to the brake or other device by simple friction, or the friction of magnetism, as in fig. 1, so that the armature, B, is free to take up various positions in relation to the brake-lever, C, and yet control it. I limit the play of the brake or its lever between two stops, D D, this play being preferably very small, but the regulating armature or core, B, may have a much longer travel, or play ; thus it will be seen, as above stated, that the armature may take up various positions in relation to the brake-lever, the particular position, however, being determined by the strength of the current, thus no alteration in the tension-spring or balance-weight acting against the armature is necessary even for much variation in the current, as the armature will accommodate its position automatically to the current employed.

"I have found by observation that the resistance of an arc is very constant when it is of a suitable length for the size or quality of the carbons and the strength of the current, but immediately this length is exceeded in the slightest degree the resistance becomes fitful and difficult to measure.

FIG. 1.

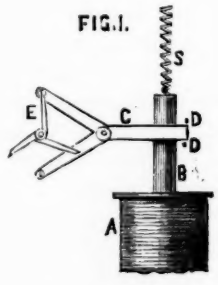


FIG. 2

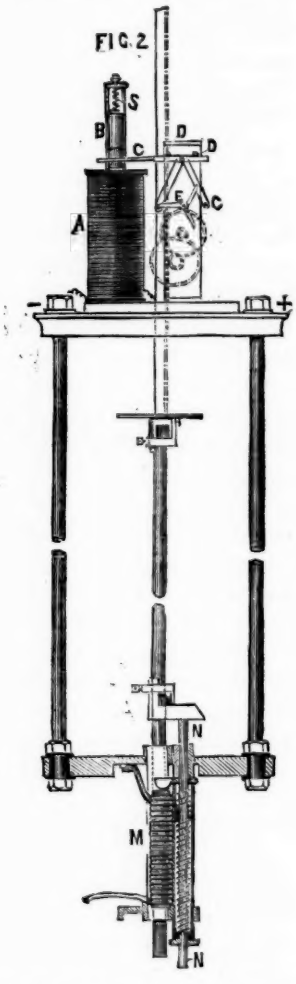
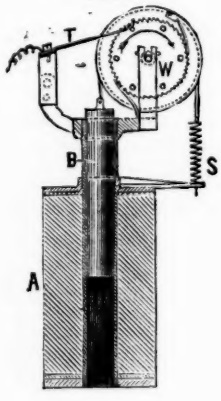


FIG. 3



"Now I take advantage of this fitful resistance of the arc to secure the readjustment of the carbons—that is to say, when the resistance of the arc becomes irregular I cause this very irregularity to produce a mechanical regulating movement, and so long as the resistance remains steady or constant no movement takes place. In order to take advantage of this irregularity in the resistance of the arc and cause it to produce mechanical action and thereby regulate an electric arc lamp, I place a solenoid or magnet, A, in a shunt across the arc, as in fig. 2, the core or armature, B, of which will vibrate when the resistance of the arc is variable and remain still when constant. I cause this core, B, to work an anchor or escapement device, C, by the friction attachment before described, which allows the carbons to approach each other a definite distance at each vibration by permitting one tooth of the escape-wheel, E, to pass, and as long as this vibratory movement continues the carbons will be gradually approaching each other or the distance between them be lessened

until the arc regains its stability, when, of course, the vibratory movement will cease and the feed be arrested. The arc in such a lamp is first obtained by means of the magnet, M, drawing down the lower carbon-holder, N.

"It will be seen that by gearing or connecting the solenoid core or magnet armature, B, to the escapement device abovementioned by means of the frictional method above explained, no alteration in the tension-spring, S, is necessary in such a lamp to suit variations in current unless those variations are very great.

"Another mode of utilising this unstability of the arc for the purposes of adjusting the carbons is to cause the oscillations of the armature or core of the shunt coil, A, fig. 3, to rotate a wheel, W, by means of a pawl and ratchet, or equivalent means, this said wheel at each revolution or part of a revolution to make a contact, T, which contact might be made to complete a branch circuit and this latter to reverse the polarity of the arc-striking or adjusting magnet in an electric lamp; indeed, I propose to use a motor which would be revolved by the oscillations of an armature due to irregularities in the resistance of an arc or current. In order to effect the re-adjustment of the arcs in electric lamps the particular construction of which lamps may be various without affecting the principle of this part of my invention."

THE ELECTRIC LIGHTING CONFERENCE IN SOUTH LONDON.

On Tuesday, the 14th inst., the adjourned conference of delegates from the various vestries and district boards of South London to consider the provisions of the Electric Lighting Act, took place in the Camberwell Vestry Hall, under the presidency of Mr. E. Dresser Rogers. We alluded to the preliminary meeting in our issue of the 4th inst.

Mr. Winnett (clerk to the Lewisham Board of Works) thought the first question to decide at this conference would be as to the action to be taken by those parishes that had not considered the question of electric lighting. In his opinion it would be advisable that the vestries should take out a licence, which, at the end of seven years, came to an end without any conditions whatever. He threw it out as a suggestion that certain definite rules should be drawn up by the united vestries and district boards to be inserted either in a licence or provisional order.

Mr. Morton (Wandsworth Board of Works) was of opinion that the district boards should not play into the hands of the companies before more was known than at present concerning electricity and what could be done by the companies. He moved the following motion: "That in the opinion of this conference it is desirable that the supply of the electric light, both for public and private purposes, should be in the hands of the local authorities. That, considering the present uncertainty as to the cost of applying the electric light over large areas, and bearing in mind that the City Corporation are about to at once try the experiment of supplying the light to all persons in the City, it would be, in the opinion of this conference, wise and to the interest of the ratepayers that the local authorities should take no further steps in the matter for a time, except to prevent companies from creating monopolies in the various districts, and to be prepared as soon as fuller information could be had as to the cost, &c., of supplying the light, to give the public the advantage of so excellent a means of lighting."

This having been seconded, the Chairman, in reply to a questioner, stated that the Board of Works, with the intention of encouraging electric lighting, were induced to accept a contract with the Jablochkoff Company to light the Thames Embankment. Since then they had gradually increased the number of lights, and they had never for a single night ceased to have the electric light under their control. All he could say was that the cost of electric lighting was found by the board to be very much less than it was at first. The progress made had been so far satisfactory that the Embankment had been lighted at a difference of cost of something like three-halfpence per candle per hour as compared with sixpence. He would say nothing about the difference between the cost of electricity and gas.

Mr. Fowler (Lambeth) could not support the motion of Mr. Morton. In the first place the Act of Parliament could not be over-ridden by anything or anybody. The vestries and district boards were at the mercy of the Act, and it came to this—that the vestries would be compelled to do something themselves, or oppose the companies with the object of obtaining the best terms possible in the interests of the ratepayers. The chief difficulty he saw in adopting the electric light was the enormous cost of undertaking it. The money must come from some quarter, and it was questionable whether the Metropolitan Board would be disposed to lend it on such a security. This conference should hesitate before doing anything in the dark. There were several features in the Act which might have been objected to had it secured adequate attention at the hands of those interested in it before it was passed.

Mr. Dunham (clerk to the Newington Vestry) pointed out that although Newington would apply for a licence for the whole area of the parish, the compulsory clauses would only refer to the main roads. It would be permissive on the part of the Vestry to light the bye-streets with electricity. Referring to Mr. Chandler's figures given at the last conference, Mr. Dunham remarked that it did not follow that because the first four miles of streets would cost an initial £8,000, the other thoroughfares would cost the same in proportion. As a matter of fact, he did not think it would cost Newington more than £15,000 to start with. Supposing that the rates were increased twopence or threepence in the pound, would it not be a good investment if they succeeded in bringing down the price of gas? His (Mr. Dunham's) opinion was that the vestries ought certainly to take advantage of the Act at the present time.

Mr. Middlemass (Camberwell) said it was important to bear in mind that the cost of electricity would be less and less every year. The cost of electricity in the past had included the cost of experiments, but in the future it would simply be the commercial cost of the article in proportion to the number of persons to be supplied. He commended the action of Newington in this matter. The vestries would be neglecting their duty to their constituents if they failed to take steps to possess the option of supplying the electric light, and of preventing anybody obtaining a monopoly.

The resolution was put and negatived, only two voting in its favour.

Mr. Winnett then moved—"That this conference recommends such vestries and district boards as do not intend to become undertakers themselves, to grant consent to licence to such companies as they may select, and upon such conditions as may be determined, thus preventing the provisional orders being obtained."

Lieutenant-General Mould seconded.

Mr. Fowler deprecated the consideration of such matters as those contained in the resolution, and reminded the conference that the broad issue was whether the vestries should be recommended to take out a licence. It did not follow, even supposing the licence was taken out by the parish, that the vestries should themselves undertake the actual lighting.

Mr. Yates remarked that even if they did not undertake the actual licence, they would be responsible for it at the cost of the ratepayers.

Mr. Middlemass opposed the resolution, and remarked that the vestries would be guilty of cowardice if they failed to accept the responsibilities laid upon them by the Electric Lighting Act.

The resolution, which was only supported by three gentlemen, was negatived.

Mr. Fowler moved—"That it be reported to the various vestries and district boards, that inasmuch as the provisions of the Electric Lighting Act require local authorities to elect, before the 25th of January next, either to apply for licences themselves, or permit the undertakers to apply for provisional orders; and inasmuch as the President of the Board of Trade has declared that the Act of Parliament must be carried out, in the opinion of this conference the local authorities should be advised to apply for licences so as to keep the power in their own hands."

Mr. Middlemass seconded, and the resolution was carried with only one dissentient, and the proceedings closed with a vote of thanks to the chairman and to the vestry of Camberwell for having called the conference together.

The Chairman, in reply to the vote of thanks, reminded

the delegates that he took great interest in the gas question twenty-five years ago. He hoped and trusted that the work of the delegates would result in an improvement in the lighting of our streets in the future by the electric light.

The proceedings then terminated.

At a meeting of the Camberwell Vestry on the following evening the advisability of holding a special meeting to consider the best means of adopting the Electric Lighting Act was discussed. Mr. E. Dresser Rogers again presided and there were about fifty gentlemen present.

Mr. Middlemass, in a speech dealing exhaustively with the subject of improved lighting, moved—"That the vestry clerk be directed to convene a special meeting of the vestry, with one month's notice pursuant to the statute, in order to enable the vestry to decide whether a licence shall be applied for by the vestry, or consent given to a licence or provisional order to one or some of the electric light companies."

The motion was seconded, when

Mr. Preston moved, as an amendment, to add to the above motion the words—"or what steps, if any, the vestry will take in the matter."

The motion as amended was agreed to, after a somewhat lengthy discussion.

Mr. Middlemass then moved, pursuant to notice—"That the vestry clerk and the surveyor be directed to obtain information as to the views and terms of the electric lighting companies for the supply of the public and private lighting of the parish."

Mr. Duckett seconded the motion.

Mr. Simmons moved, and Mr. Duckett seconded, to add to the motion the words—"And that the same be summarised, printed, and sent to the members one week before the meeting is called."

This amendment was carried as part of the original resolution, which was also adopted.

This terminated the proceedings.

DR. SIEMENS' ADDRESS TO THE SOCIETY OF ARTS.

After some preliminary remarks on the history and formation of the above Society, Dr. Siemens said:—

Amongst the practical questions that now chiefly occupy public attention are those of electric lighting, and of the transmission of force by electricity.

The dynamo machine, which enables us to convert mechanical into electrical force, purely and simply, properly conceived and well constructed, converts more than ninety per cent. of the mechanical force imparted to it into electricity, ninety per cent. again of which may be re-converted into mechanical force at a moderate distance. The margin of loss, therefore, does not exceed twenty per cent., excluding purely mechanical losses, and this is quite capable of being further reduced to some extent by improved modes of construction; but it results from these figures that no great step in advance can be looked for in this direction. The dynamo machine presents the great advantage of simplicity over steam or other power-transmitting engines; it has but one working part, namely, a shaft which, revolving in a pair of bearings, carries a coil or coils of wire admitting of perfect balancing. Frictional resistance is thus reduced to an absolute minimum, and no allowance has to be made for loss by condensation, or badly fitting pistons, stuffing boxes, or valves, or for the jerking action due to oscillating weights. The materials composing the machine, namely, soft iron and copper wire, undergo no deterioration or change by continuous working, and the depreciation of value is, therefore, a minimum, except where currents of exceptionally high potential are used, which appear to render the copper wire brittle.

The essential points to be attended to in the conception of the dynamo machine are the prevention of induced currents in the iron, and the placing of the wire in such position as to make the whole of it effective for the production of outward current. These principles, which have been clearly established by the labours of comparatively few workers in applied science, admit of being carried out in an almost infinite variety of constructive forms, for each of which may be claimed some real or imaginary merits regarding questions of convenience or cost of production.

The essential features involved in the dynamo machine, the Siemens armature (1856), the Pacinotti ring (1861), and the self-exciting principle (1867), were published by their authors for the pure scientific interest attached to them, without being made subject matter of letters patent, which circumstance appears to have had the contrary effect of what might have been expected, in that it has retarded the introduction of this class of electrical machine, because no person or firm, had a sufficient commercial interest to undertake the large expenditure which must necessarily be incurred in reducing a first conception into a practical shape. Great credit is due to Monsieur Gramme for taking the initiative in the practical introduction of dynamo machines embodying those principles, but when five years ago I ventured to predict for the dynamo-electric current a great practical future, as a means of transmitting power to a distance, those views were still looked upon as more or less chimerical. A few striking examples of what could be practically effected by the dynamo-electric current, such as the illumination of the Place de l'Opéra, Paris, the occasional exhibition of powerful arc lights, and their adoption for military and lighthouse purposes, but especially the gradual accomplishment of the much-desired lamp by incandescence in vacuum, gave rise to a somewhat sudden reversion of public feeling; and you may remember the scare at the Stock Exchange, affecting the value of gas shares, which ensued in 1878, when the accomplishment of the subdivision of the electric light by incandescent wire was first announced, somewhat prematurely, through the Atlantic cable.

From this time forward electric lighting has been attracting more and more public attention, until the brilliant displays at the Exhibition of Paris, and at the Crystal Palace last year, served to excite public interest to an extraordinary degree. New companies for the purpose of introducing electric light and power have been announced almost daily, whose claims to public attention as investments were based in some cases upon only very slight modifications of well-known forms of dynamo machines, of arc regulators, or of incandescent carbon lights, the merits of which rested rather upon anticipations than upon any scientific or practical proof. These arrangements were supposed to be of such superlative merit that gas and other illuminants must soon be matters simply of history, and hence arose great speculative excitement. It should be borne in mind, however, that any great technical advance is necessarily the work of time and serious labour, and that when accomplished, it is generally found that so far from injuring existing industries, it calls additional ones into existence, to supply new demands, and thus gives rise to an increase in the sum total of our resources. It is, therefore, reasonable to expect that side by side with the introduction of the new illuminant, gas lighting will go on improving and extending, although the advantage of electric light for many applications, such as the lighting of public halls and warehouses, of our drawing-rooms and dining-rooms, our passenger steamers, our docks and harbours, are so evident, that its advent may be looked upon as a matter of certainty.

Our Legislature has not been slow in recognising the importance of the new illuminant. In 1879 a Select Committee of the House of Commons instituted a careful inquiry into its nature and probable cost, with a view to legislation, and the conclusions at which they arrived were, I consider, the best that could have been laid down. They advised that applications should be encouraged tentatively by the granting of Permissive Bills, and this policy has given rise to the Electric Lighting Bill, 1882, promoted by Mr. Chamberlain, the President of the Board of Trade, regarding which much controversy has arisen. It could, indeed, hardly be expected that any act of legislation upon this subject could give universal satisfaction, because while there are many believers in gas who would gladly oppose any measure likely to favour the progress of the rival illuminant, and others who wish to see it monopolised, either by local authorities, or by large financial corporations, there are others again who would throw the doors open so wide as to enable almost all comers to interfere with the public thoroughfares, for the establishment of conducting wires, without let or public hindrance.

The law as now established takes, I consider, a medium course between these diverging opinions, and, if properly interpreted, will protect, I believe, all legitimate interests, without impeding the healthy growth of establishments for the distribution of electric energy for lighting and for the transmission of power. Any firm or lighting company may, by application to the local authorities, obtain leave to place electric conductors below public thoroughfares, subject to such conditions as may be mutually agreed upon, the term of such licence being limited to seven years; or an application may be made to the Board of Trade for a Provisional Order to the same effect, which, when sanctioned by Parliament, secures a right of occupation for twenty-one years. The licence offers the advantage of cheapness, and may be regarded as a purely tentative measure, to enable the firm or company to prove the value of their plant. If this is fairly established, the licence would in all probability be affirmed, either by an engagement for its prolongation from time to time, or by a Provisional Order which would, in that case, be obtained by joint application of the contractor and the local authority. At the time of expiration of the Provisional Order, pre-emption of purchase is accorded to the local authority, against which it has been objected with much force by so competent an authority as Sir Frederick Bramwell, that the conditions of purchase laid down are not such as fairly to remunerate the contracting companies for their expenditure and risk, and that the power of purchase would inevitably induce the parochial bodies to become mere trading associations. But while admitting the undesirability of such a consummation, I cannot help thinking that it was necessary to put some term to contracts entered into with speculative bodies at a time when the true value of electric energy, and the best conditions under which it should be applied, are still very imperfectly understood. The supply of electric energy, particularly in its application to transmission of power, is a matter simply of commercial demand and supply, which need not partake of the character of a large monopoly similar to gas and water supply, and which may, therefore, be safely left in the hands of individuals, or of local associations, subject to a certain control for the protection of public interests. At the termination of the period of the Provisional Order, the contract may be renewed upon such terms and conditions as may at that time appear just and reasonable to Parliament, under whose authority the Board of Trade will be empowered to effect such renewal.

Complaints appear almost daily in the public papers, to the effect that townships refuse their assent to applications by electric light companies for Provisional Orders; but it may be surmised that many of these applications are of a more or less speculative character, the

object being to secure monopolies for eventual use or sale, under which circumstances the authorities are clearly justified in withholding their assent; and no licences or Provisional Orders should indeed be granted, I consider, unless the applicants can give assurance of being able and willing to carry out the work within a reasonable time. But there are technical questions involved which are not yet sufficiently well understood to admit of immediate operations upon a large scale.

Attention has been very properly called to the great divergence in the opinions expressed by scientific men regarding the area that each lighting district should comprise, the capital required to light such an area, and the amount of electric tension that should be allowed in the conductors. In the case of gas supply, the works are necessarily situated in the outskirts of the town, on account of the nuisance this manufacture occasions to the immediate neighbourhood; and, therefore, gas supply must range over a large area. It would be possible, no doubt, to deal with electricity on a similar basis, to establish electrical mains in the shape of copper rods of great thickness, with branches diverging from them in all directions; but the question to be considered is, whether such an initiative course is desirable on account either of relative expense or of facility of working. My own opinion, based upon considerable practical experience and thought devoted to the subject, is decidedly adverse to such a plan. In my evidence before the Parliamentary Committee, I limited the desirable area of an electric district in densely populated towns to a quarter of a square mile, and estimated the cost of the necessary establishment of engines, dynamo machines, and conductors, at £100,000, while other witnesses held that areas from one to four square miles could be worked advantageously from one centre, and at a cost not exceeding materially the figure I had given. These discrepancies do not necessarily imply wide differences in the estimated cost of each machine or electric light, inasmuch as such estimates are necessarily based upon various assumptions regarding the number of houses and of public buildings comprised in such a district, and the amount of light to be apportioned to each, but I still maintain my preference for small districts.

By way of illustration, let us take the parish of St. James's, near at hand, a district not more densely populated than other equal areas within the metropolis, although comprising, perhaps, a greater number of public buildings. Its population, according to the preliminary report of the census taken on the 4th April, 1881, was 29,865, it contains 3,018 inhabited houses, and its area is 784,000 square yards, or slightly above a quarter of a square mile.

To light a comfortable house of moderate dimensions in all its parts, to the exclusion of gas, oil, or candles, would require about 100 incandescence lights of from 15 to 18 candle-power each, that being, for instance, the number of Swan lights employed by Sir William Thomson in lighting his house at Glasgow University. Eleven horse-power would be required to excite this number of incandescence lights, and at this rate the parish of St. James's would require $3{,}018 \times 11 = 33{,}200$ horse-power to work it. It may be fairly objected, however, that there are many houses in the parish much below the standard here referred to, but on the other hand, there are 600 of them with shops on the ground-floor, involving larger requirements. Nor does this estimate provide for the large consumption of electric energy that would take place in lighting the eleven churches, eighteen club-houses, nine concert halls, three theatres, besides numerous hotels, restaurants, and lecture halls. A theatre of moderate dimensions, such as the Savoy Theatre, has been proved by experience to require 1,200 incandescence lights, representing an expenditure of 133 horse-power; and about one half that power would have to be set aside for each of the other public buildings here mentioned, constituting an aggregate of 2,926 horse-power; nor does this general estimate comprise street lighting, and to light the six and a half miles of principal streets of the parish with electric light, would require, per mile, thirty-five arc lights of 350 candle-power each, or a total of 227 lights. This, taken at the rate of 0·8 horse-power per light, represents a further requirement of 182 horse-power, making a total of 3,108 horse-power, for purposes independent of house lighting, being equivalent to one horse-power per inhabited house, and bringing the total requirements up to 109 lights = 12 horse-power per house.

I do not, however, agree with those who expect that gas lighting will be entirely superseded, but have, on the contrary, always maintained that the electric light, while possessing great and peculiar advantages for lighting our principal rooms, halls, warehouses, &c., owing to its brilliancy, and more particularly to its non-interference with the healthful condition of the atmosphere, will leave ample room for the development of the former, which is susceptible of great improvement, and is likely to hold its own for the ordinary lighting up of our streets and dwellings.

Assuming, therefore, that the bulk of domestic lighting remains to the gas companies, and that the electric light is introduced into private houses, only, at the rate of, say, twelve incandescence lights per house, the parish of St. James's would have to be provided with electric energy sufficient to work $(9 + 12)\ 3{\cdot}018 = 63{,}378$ lights = 7,042 horse-power effective; this is equal to about one-fourth the total lighting power required, taking into account that the total number of lights that have to be provided for a house are not all used at one and the same time. No allowance is made in this estimate for the transmission of power, which, in course of time, will form a very large application of electric energy; but considering that power will be required mostly in the day time, when light is not needed, a material increase in plant will not be necessary for that purpose.

In order to minimise the length and thickness of the electric conductor, it would be important to establish the source of power, as nearly as may be, in the centre of the parish, and the position that suggests itself to my mind is that of Golden Square. If the unoccupied area of this square, representing 2,500 square yards, was excavated to a depth of twenty-five feet, and then arched over so as to re-establish the present ground level, a suitable covered space would be provided for the boilers, engines, and dynamo machines, without causing obstruction or public annoyance; the only erection above the surface would be the chimney, which, if made monumental in form, might be placed in the centre of the square, and be combined with shafts for ventilating the subterranean chamber, care being taken of course to avoid smoke by insuring perfect combustion of the fuel used. The cost of such a chamber, of engine-power, and of dynamo machines capable of converting that power into electric energy, I estimate at £140,000. To this expense would have to be added that of providing and laying the conductors, together with the switches, current-regulators, and arrangements for testing the insulation of the wire.

The cost and dimensions of the conductors would depend upon their length and the electromotive force to be allowed. The latter would no doubt be limited, by the authorities, to the point at which contact of the two conductors with the human frame would not produce injurious effects, or say, to 200 volts, except for street lighting, for which purpose a higher tension is admissible. In considering the proper size of conductor to be used in any given installation two principal factors have to be taken into account; first, the charge for interest and depreciation on the original cost of a unit length of the conductor; and, secondly, the cost of the electrical energy lost through the resistance of a unit of length. The sum of these two, which may be regarded as the cost of conveyance of electricity, is clearly least, as Sir William Thomson pointed out some time ago, when the two components are equal. This, then, is the principle on which the size of a conductor should be determined.

From the experience of large installations I consider that electricity can, roughly speaking, be produced in London at a cost of about one shilling per 10,000 Ampère-Volts or Watts (746 Watts being equal to one horse-power) for an hour. Hence, assuming that each set of four incandescence lamps in series (such as Swan's, but for which may be substituted a smaller number of higher resistance and higher luminosity) requires 200 volts electromotive force and 60 Watts * for their efficient working, the total current required for 64,000 such lights is 19,200 ampères, and the cost of the electric energy lost by this current in passing through 1-100th of an ohm resistance is £16 per hour.

The resistance of a copper bar one quarter of a mile in length and one square inch in section is very nearly 1-100th of an ohm, and the weight is about 2½ tons. Assuming, then, the price of insulated copper conductor at £90 per ton, and the rate of interest and depreciation at 7½ per cent., the charge per hour of the above conductor, when used eight hours per day, is 1¼d. Hence, following the principle I have stated above, the proper size of conductor to use for an installation of the magnitude I have supposed would be one of 48·29 in. section, or a round rod 8 in. diameter.

If the mean distance of the lamps from the station be assumed as 350 yards the weight of copper used in the complete system of conductors would be nearly 168 tons, and its cost £15,120. To this must be added the cost of iron pipes for carrying the conductors underground, and of testing-boxes and labour in placing them. Four pipes of 10 in. diameter each would have to proceed in different directions from the central station, each containing sixteen separate conductors of 1 in. diameter and separately insulated, each of them supplying a sub-district of 1,000 lights. The total cost of establishing these conductors may be taken at £37,000, which brings up the total expenditure for central station and leads to £177,000. I assume the conductors to be placed underground, as I consider it quite inadmissible, both as regards permanency and public safety and convenience, to place them above ground within the precincts of towns. With this expenditure the parish of St. James's could be supplied with the electric light to the extent of about 25 per cent. of the total illuminating power required. To provide a larger percentage of electric energy would increase the cost of establishment proportionately, and that of conductors nearly in the square ratio of the increase of the district, unless the loss of energy by resistance is allowed to augment instead.

It may surprise uninitiated persons to be told that to supply a single parish with electric energy necessitates copper conductors of a collective area equal to a rod of eight inches in diameter; and how, it may be asked, will it be possible under such conditions to transmit the energy of waterfalls to distances of twenty or thirty miles, as has been suggested. It must indeed be admitted that the transmission of electric energy of such potential (200 volts) as is admissible in private dwellings would involve conductors of impracticable dimensions, and in order to transmit electrical energy to such distances it is necessary to resort in the first place to an electric current of high tension. By increasing the tension from 200 to 1,200 volts the conductors may be reduced to one-sixth their area, and if we are content to lose a larger proportion of the energy obtained cheaply from a waterfall, we may effect a still greater reduction. A current of such high potential could not be introduced into houses for lighting purposes, but it could be passed through the coils of a secondary dynamo machine, to give motion to another primary machine, producing currents of low potential to be distributed for general consumption. Or secondary batteries may be used to effect the conversion of currents of high into those of low potential, whichever means may be found the cheaper in first cost, in maintenance, and most economical of energy. It may be advisable to have several such relays of energy for great distances, the result of which would be a reduction of the size and cost of conductor at the expense of final effect, and the policy of the electrical engineer will, in such cases, have to be governed by the relative cost of the conductor, and of the power at its original source. If secondary batteries should become more permanent in their action than they are at the present time, they may be largely resorted to by consumers, to receive a charge of electrical energy during the day time, or the small hours of the night, when the central engine would otherwise be unemployed, and the advantage of resorting to these means will depend upon the relative first cost, and cost of working the secondary battery and the

* We presume Dr. Siemens means 60 Watts per lamp.—Eds. Elec. Rev

engine respectively. These questions are, however, outside the range of our present consideration.

The large aggregate of dwellings comprising the metropolis of London covers about seventy square miles, thirty of which may be taken to consist of parks, squares, and sparsely-inhabited areas, which are not to be considered for our present purpose. The remaining forty square miles could be divided into, say, 140 districts, slightly exceeding a quarter of a square mile on the average, but containing each fully 3,000 houses, and a population similar to that of St. James's.

Assuming twenty of these districts to rank with the parish of St. James's (after deducting the 600 shops which I did not include in my estimate) as central districts, sixty to be residential districts, and sixty to be comparatively poor neighbourhoods, and estimating the illuminating power required for these three classes in the proportion of 1 to $\frac{2}{3}$ to $\frac{1}{5}$, we should find that the total capital expenditure for supplying the metropolis with electric energy to the extent of 25 per cent. of the total lighting requirements would be—

$$20 \times 1 \times 177{,}000 = £3{,}540{,}000$$
$$60 \times \tfrac{2}{3} \times 177{,}000 = £7{,}080{,}000$$
$$60 \times \tfrac{1}{5} \times 177{,}000 = £3{,}540{,}000$$
$$£14{,}160{,}000$$

or, say, £14,000,000, without including lamps and internal fittings, and making an average capital expenditure of £100,000 per district.

To extend the same system over the towns of Great Britain and Ireland would absorb a capital exceeding, certainly £64,000,000, to which must be added £16,000,000 for lamps and internal fittings, making a total capital expenditure of £80,000,000. Some of us may live to see this realised, but to find such an amount of capital, and, what is more important, to find the manufacturing appliances to produce work representing this value of machinery and wire, must necessarily be the result of many years of technical development. If, therefore, we see that electric companies apply for Provisional Orders to supply electric energy, not only for every town throughout the country, but also for colonies and for foreign parts, we are forced to the conclusion that their ambition is somewhat in excess of their power of performance; and that no Provisional Order should be granted except conditionally on the work being executed within a reasonable time, as without such a provision the powers granted may have the effect of retarding instead of advancing electric lighting, and of providing an undue encouragement to purely speculative operations.

The extension of a district beyond the quarter of a square mile limit would necessitate an establishment of unwieldly dimensions, and the total cost of electric conductors per unit area would be materially increased; but independently of the consideration of cost, great public inconvenience would arise in consequence of the number and dimensions of the electric conductors, which could no longer be accommodated in narrow channels placed below the kerb stones, but would necessitate the construction of costly subways—veritable *cava electrica*.

The amount of the working charges of an establishment comprising the parish of St. James's would depend on the number of working hours in the day, and on the price of fuel per ton. Assuming the 64,000 lights to incandesce for six hours a day, the price of coal to be 20s. a ton, and the consumption 2 lbs. per effective horse-power per hour, the annual charge under this head, taking eight hours' firing, would amount to about £18,300, to which would have to be added for wages, repairs, and sundries, about £6,000, for interest with depreciation at seven and a-half per cent., £13,300, and for general management, say, £3,4000, making a total annual charge of £41,000, or at the rate of 12s. 9½d per incandescence lamp per annum. To this has to be added the cost of renewal of lamps, which may be taken at 5s. per lamp of 16 candles, lasting 1,200 hours, or to 9s. per annum, making a total of 21s. 9½d. per lamp for a year.

In comparing these results with the cost of gas lighting we shall find that it takes five cubic feet of gas, in a good argand burner, to produce the same luminous effect as one incandescence light of 16 candle-power. In lighting such a burner every day, for six hours on the average, we obtain an annual gas consumption of 10,950 cubic feet, the value of which, taken at the rate of 2s. 8d. per thousand, represents an annual charge of 29s., showing that electric light by incandescence, when carried out on a large scale, is decidedly cheaper than gas lighting at present prices, and with the ordinary gas burners.

On the other hand, the cost of establishing gas works and mains of a capacity equal to 64,000 argand burners would involve an expenditure not exceeding £80,000, as compared with £177,000 in the case of electricity; and it is thus shown that although it is more costly to establish a given supply of illuminating power by electricity than gas, the former has the advantage as regards current cost of production.

It would not be safe, however, for the advocates of electric lighting to rely upon these figures as representing a permanent state of things. In calculating the cost of electric light, I have only allowed for depreciation and 5 per cent. interest upon capital expenditure, whereas gas companies are in the habit of dividing large dividends, and can afford to supply gas at a cheaper rate, by taking advantage of recent improvements in manufacturing operations, and of the ever-increasing value of their by-products, including tar, coke, and ammoniacal liquor. Burners have, moreover, been recently devised by which the luminous effect for a given expenditure of gas can be nearly doubled by purely mechanical arrangements, and the brilliancy of the light can be greatly improved.

On the other hand, electric lighting also may certainly be cheapened by resorting, to a greater extent than has been assumed, to arc lighting, which, though less agreeable than the incandescence light for domestic purposes, can be produced at less than half the cost, and deserves on that account the preference for street lighting, and for large halls, in combination with incandescence lights. Lamps by incandescence may be produced hereafter at a lower cost, and of a more enduring character.

Considering the increasing public demand for improved illumination, it is not unreasonable to expect that the introduction of the electric light to the full extent here contemplated, would go hand-in-hand with an increasing consumption of gas for illuminating and for heating purposes, and the neck-to-neck competition between the representatives of the two systems of illumination, which is likely to ensue, cannot fail to improve the quality, and to cheapen the supply of both, a competition which the consuming public can afford to watch with complacent self-satisfaction. Electricity must win the day, as the light of luxury; but gas will, at the same time, find an ever-increasing application for the more humble purposes of diffusing light.

In my address to the British Association I dwelt upon the capabilities and prospects of gas, both as an illuminant and as a heating agent, and I do not think that I was over sanguine in predicting for this combustible a future exceeding all present anticipations.

I showed that if supplied specially for the purpose, it would become not only the most convenient, but by far the cheapest form of fuel that can be delivered to our towns. Such a general supply of heating separately from illuminating gas, by collecting the two gases into separate holders during the process of distillation, would have the beneficial effects—

1st. Of giving to lighting gas a higher illuminating power.

2nd. Of relieving our towns of their most objectionable traffic, that in coal and ashes.

3rd. Of effecting the perfect cure of that bugbear of our winter existence—the smoke nuisance.

4th. Of largely increasing the production of those valuable bye-products, tar, coke, and ammonia, the annual value of which already exceeds by nearly £3,000,000 that of the coal consumed in the gas works.

Dr. Siemens concluded his able discourse by remarking that he considered the Society of Arts to be the proper body to thoroughly examine the question of the application of gas and electricity for lighting purposes, &c., and that he would be well pleased if he could be instrumental in engaging the Society's attention to such an important matter.

SNELL'S PATENT ELECTRIC ARC LAMP.

In this lamp a single electro-magnet in a derived circuit is used to make and regulate the arc, and all rack or clock-work dispensed with.

As can be seen from the diagrams, a brake attached to a soft iron core is actuated by the magnetism in the core to regulate the descent of the enclosed rod which forms the upper carbon-holder, the downward motion of the core due to the action of the solenoid upon it being resisted by the spring beneath.

The lower carbon-holder is held by an insulated strap to which one terminal is attached, the other terminal being on the bobbin of the solenoid and projecting through the case which encloses and protects all the mechanism.

As a means of reducing the resistance the upper carbon is fed by two copper strips which touch it near its lower end; they are gently pressed against the carbon by the hinged weights attached to the wires from the base plate above, and are easily separated by the carbon-holder when the rod has descended sufficiently.

The brake is shown in fig. 2, and an enlarged section is given in fig. 3. It consists of a brass arm on each side of the core with a soft iron armature forming the connection between them at the back, these arms being pivoted to the core and carrying a brake-block opposite the armature. This block passes through a slot in the core and presses upon the enclosed rod or carbon-holder, keeping it in position, so that the movements of the rod and carbon are (so far) the same as those of the core itself. A weighted arm is screwed through the armature which allows, by the adjustment of the weight, the regulation of the descent of the carbon and rod with simplicity and extreme delicacy, and also serves to regulate the play between the armature and the core.

When the lamp is in action, any increase in the normal distance between the carbons increases the current in the solenoid, or shunt circuit, which, acting on the core, causes a more powerful attraction between that and the armature, the result being that the pressure of the brake-block upon the rod is lessened, and the rate of descent of the rod is augmented.

This brake being controlled by magnetism (in the core), gives great sensibility, and a steady and continuous descent of the rod should be insured.

The antagonism between the spring and core also helps to

adjust the arc, for if in any case the feed should be excessive, the resulting lessening of the power of the solenoid would cause firmer application of the brake, and lifting of the core and rod by the spring, until the right amount of separation between the carbons was again attained.

Should the light be accidentally extinguished, the power of the solenoid being increased would cause the release of the brake and descent of the core, until contact was again established, when the immediate rising of the core and rod (for the brake would then be applied) by the action of the spring would cause the normal distance to be again attained.

FIG. 1.

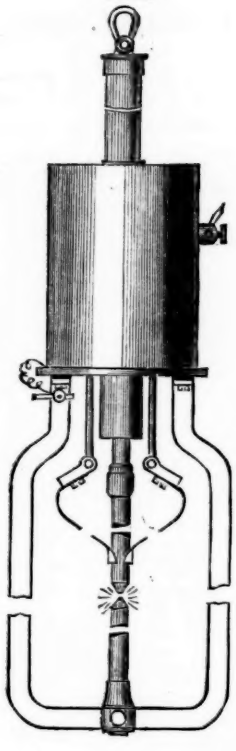


FIG. 2.

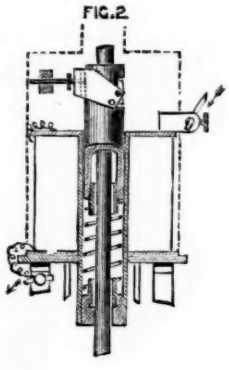
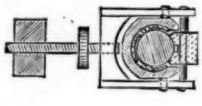


FIG. 3



From the above it will be seen that by means of the weight on the arm attached to the brake armature, the position of the carbons is regulated in such a manner as to guarantee, in the inventor's opinion, a steady and very certain action, whilst liability to derangement is reduced to a minimum.

Any number of lamps may, of course, be placed in one circuit, according to the electromotive force of the generating machine, and the lamp is said to work with currents of very different intensities without changing any part of its mechanism.

It is simple, and apparently reliable; sensitive and easy of adjustment; and certainty of action might, therefore, be guaranteed with safety.

The vibrations which would be produced by alternating currents would be especially favourable to its working.

We have not yet seen this lamp in operation, but we have no reason to doubt its efficiency, and we congratulate Mr. Snell on what we believe to be his first inventive effort in electric lighting apparatus.

One advantage in Snell's lamp is the absence of any coil in the main circuit to absorb a part of the current passing between the terminals, and as almost every other arc lamp has such a coil in addition to the shunt electro-magnet or solenoid this advantage is a material one.

Its cost should be very slight compared with many others at present in use, and therefore its selling price ought naturally to be equally low. We hope shortly to see this lamp in action, when we shall again refer to it. As far as we can judge at present Mr. Snell appears to have produced as simple a lamp of the kind as can well be expected, and we shall be glad to hear of its successful operation in practical working. The invention is patented in England and abroad, but we do not know what special claims are made.

Now that so many arc lamps have been brought forward, one would almost think that inventors should turn their thoughts in other directions, but as Dr. Siemens very truly remarked in his address to the Society of Arts, which we publish in this issue, if the greatest economy is wished for from the electric light then arc lamps must be employed, and it may be inferred that the learned doctor does not agree with the opinion now openly expressed by many that electric lighting by means of arc lamps has had its day. Therefore, as far as arc lights go we may expect to see some of those at present in use superseded by others of a more simple, *cheap*, and reliable character, and Mr. Snell's simple lamp, which may probably be rendered still more so, appears to promise well.

DETECTION BY ELECTRICITY OF THE ANNUAL CULMINATIONS OF THE SOLAR INFLUENCE ON ORGANISMS.*

By NILS KOLKIN.

It came to my notice several years ago that, if one end of a hair or thread were tied to a watch-key or some similar object, and a person, seated comfortably before a table, with his elbow resting on the same, took hold of the other end, so as to raise the key from the table and keep it suspended, it was impossible to keep it still, in spite of all precautions. Oscillations would begin which, if the hands were warm, would attain great violence. If the key were permitted to strike against anything except glass, silk, dry rusty iron, or other bad conductors of electricity, the oscillations would be interrupted by short pauses occurring at regular intervals; and the strokes between these pauses would correspond with the age of the hair, or, more correctly, their number would show how many years old the person was when he lost it. I understood that these oscillations were caused by electricity; that the key was positively or negatively charged and repelled by the arm and hand, which were similarly charged.

I have since investigated this phenomenon, as much as my time has allowed, and I shall here carefully give the results of my experiments. I have also substituted electricity from other sources than that used in those primitive experiments, and, when I have not met the same success, it is due to the fact that I am not a practical electrician.

There is no known principle that accounts for the pauses in the oscillations. But the explanation seems to be that—*When any organic substance is continually charged by positive or negative electricity, and discharged in rapid succession, under certain circumstances, the substance itself, and things in contact with it, will, after a certain number of discharges, for a moment become non-conductors; and the number of those discharges will correspond to the age of the vegetable or animal from which the substance is derived.* I say "under certain circumstances," for I do not know whether repulsion and attraction is necessary or not. My experiments have always been with a suspended key, except with a metallic spring, placed horizontally, which is virtually the same thing. The resistance to electricity during the pause is, indeed, very slight; it does not take a very powerful charge to overcome it. The weaker the supply of electricity, the better it is. Shortening the fibre by which the key is suspended will give the best results. It will make the oscillations more rapid, and they ought to be rapid enough to make it necessary to count them by twos, for the pause will thus be better noticed.

All organic substances possess this age-telling property, except absolute non-conductors, as silk. If substances of different ages are used together the age of the oldest only is shown. This fact makes it possible to find the age of substances of all forms, even with a suspended key. A fibre of an annual plant may be used and any dry substance tied in it; in case of liquids, the fibre may be satu-

* American Association for the Advancement of Science.

rated with them. Liquids are good conductors and must be guarded against. The smallest particle of juice, or sweat, on anything, when of higher age, will show its presence.

The age of a substance here must not be taken to mean the time it has existed as such, but that age which the vegetable or animal that may be its source had when its connection with that source was severed. A leaf may be two months old, but it shows the age of the tree; a drop of milk, that of the cow. I have permitted myself to call this "organic age;" but as we have nothing to do with any other kind here the word "age" must always be taken in this sense. Any part of an organism, any seed, fruit, secretion, or any part or product whatever, has the same organic age as its source. The age of vegetables counts from the time they sprang from seed. Those propagated from roots or cuttings have the age as the original. A potato showed between 800 and 900 years. The age of animals corresponds with what is commonly termed so; but new-born young have the same organic age as the mother.

This age-telling property of organisms does not seem to be destroyed by time. To what extent chemical changes does it I cannot say. Considerably decayed wood retains it. Some kerosene, which caused the discovery of the age-telling property of liquids, showed constantly eight years; but this might have been due to some foreign substance.

It is, of course, plain to all, that the interruption of the oscillations has nothing to do with our civil year as it is divided off in the almanac, but with a natural year. A natural year in our zone consists of an increase, a culmination, and a decrease of the solar influence. It is the number of those annual culminations to which an organism has been exposed during life that is shown. In case of annual plants, grown during the increase or decrease, they will show a year though they have not been exposed to the maximum influence of the sun. So with animals less than a year old. The oscillations generally cease very abruptly, but when a considerable fraction of a year remains uncounted, there is often a gradual subsidence into a pause. How it is with organisms under the equator, where the sun passes twice a year, I do not know. But a knowledge of it would throw some light on this question.

That the sun has great influence on plants all know; but that it should have so great an influence on animals that each annual increase, culmination, and decrease of that influence should be registered in their organisms, will seem to many a great heresy. The sun, however, has more power than is generally supposed. Many persons will know that they do not feel the same under its decrease and increase. They do not seem to be the same persons in the autumn and in the spring, everything else being equal. The influence of the sun pervades all nature, and reaches life, both animal and vegetable, in recesses completely hidden from its rays.

EBEL'S PATENT RELAY.

THE advantages which are claimed for this relay, are:— 1. Simplicity. 2. Compact arrangement of the whole, and consequently the cheapness with which it may be manufactured. 3. Extreme sensitiveness.

Fig. 4 is a general view of the instrument, and figs. 1, 2, and 3, show the arrangement of the same. In fig. 3, *a* is a bobbin of insulated wire, in which is placed a soft iron compound core consisting of *b*, *c*, c_2, and c_3. *b* is a tube, in the centre of which is placed a rod, or bar, *c* (made of extreme lightness), oscillating freely upon pivots in c_1 and c_1. On each end of rod, or bar, c_1, are attached prolongations which constitute armatures, c_2 and c_3. *ff* are permanent horse-shoe magnets connected together by rods of non-magnetic metal, *h* and h_1 (fig. 2), and pivoted at *g* and g_1 (fig. 3). The horse-shoe magnets, *ff*, are so arranged with reference to the armatures, c_2, c_3, that the latter can move to and fro between the poles of these magnets. In fig. 2, *j* and *j* are spiral springs attached to a rod, *h*, and plates, *d* and *e*, which tend to constantly draw the horse-shoe magnets in one direction. On the rod h_2 are placed adjusting screws, *i*, by which the position of the horse-shoe magnets can be regulated. To limit the play of the armatures, c_2 and c_3, a metal piece, c_4, is attached to c_2, the movement of which is controlled by two insulated contact screws, *k*, *k* (fig. 1).

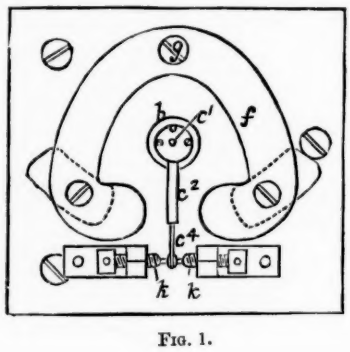
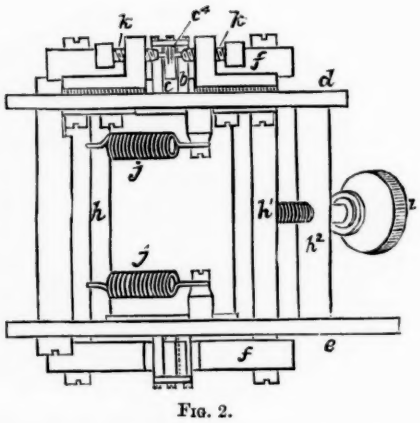


FIG. 1.



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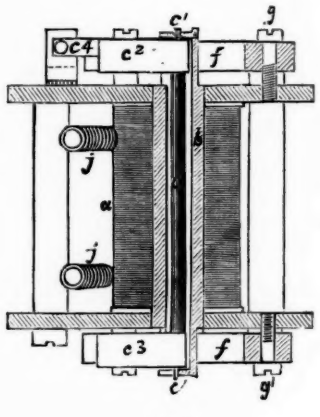

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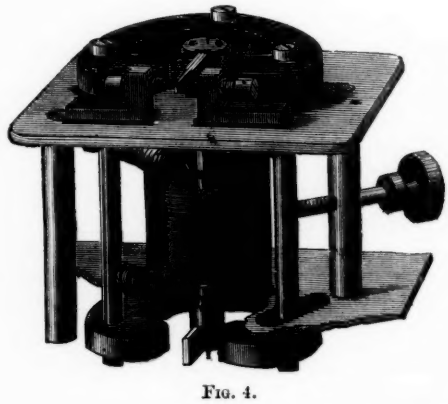

FIG. 4.

It will be seen that the whole arrangement of the Ebel relay is very compact, and as the moving parts are very light, and the amount of iron to be rendered magnetic by the working current very small, the probabilities of its working at a high speed are very great.

The Post-office standard relay will give perfect signals when worked with one-third of a milliampère of current (one Daniell cell through 3,000 ohms, approximately), and we think that the Ebel relay should do as equally well as this.

Altogether the advantages which the inventor claims for his relay are not, we consider, exaggerated.

RATIONAL CONCEPTION OF THE NATURE AND THE PROPAGATION OF ELECTRICITY.

DEDUCED :—1. FROM THE CONSIDERATION OF THE POTENTIAL ENERGY OF ETHEREAL MATTER ASSOCIATED WITH PONDERABLE MATTER. 2. FROM THE MODE OF PRODUCTION AND OF TRANSMISSION OF WORK ACCOMPANYING THE VARIATIONS OF THIS ENERGY. (*Continued.*)

By M. A. LEDIEU.

VI. Our inductions may be summed up thus :—

1. The complete molecules of every body must be regarded each as an aggregate of ponderable atoms, and of ethereal atoms, both vibrating in relation to a system of axes passing by the centre of gravity of the aggregate, whilst the system itself oscillates with reference to an imaginary solid concerning the centres of gravity of all the molecules of the body. The ethereal atoms of each molecule form to a greater or less extent a sort of atmosphere around its ponderable nucleus. This atmosphere is independent of the cosmic ether which plays in the molecular interstices of the body.

2. The ponderable atoms have, by pairs, their mutual actions equal to $m\,m'\,f\,(l)$; $m\,m'$ representing the masses, and l the distances.

3. The ethereal atoms have all an identical mass, μ, excessively small, with reference to those of the ponderable atoms. The expression of their mutual dynamic connection is $\mu^2\,\phi\,(l)$; and the law of the reciprocal actions which associate them to the ponderable atoms is represented by $m\,\mu\,\mathrm{F}\,(l)$. By reason of the smallness of $m\,\mu$, the function $\mathrm{F}\,(l)$ must, at least for certain values of l, be considerable with reference to the two other functions of distance above $f\,(l)$ and $\phi\,(l)$. This capital supposition is necessary to explain the powerful effects which are produced between the ponderable matter and the ethereal matter.

4. Each complete molecule has constantly its physico-chemical modality mechanically specified by its *actual* energy and its *total potential* energy.

The former A of these energies is of the known form,

$$(1) \qquad \mathrm{A} = \Sigma\, m\, v^2 + \Sigma\, \mu\, v_1^2,$$

v and v_1 being the velocities at once vibratory and oscillatory, of the different kinds of atoms, with reference to the imaginary solid above mentioned, or their residual velocities with reference to the rest or the motion of the whole of the body.

On its part, the *total potential* energy, P, of the complete molecule, has its value constituted by the aid of functions of forces, and represented by

$$(2)\begin{cases} \mathrm{P} = \{\mathrm{C}_1 - f\,[\Sigma\, m\, m'\, \mathrm{F}\,(l)\, d\, l]\} \\ \quad + \{\mathrm{C}_2 - f\,[\Sigma\, \mu^2\, \psi\,(l)\, d\, l] - f \\ \qquad [\Sigma\, m\, \mu\, f\,(l)\, d\, l]\} \end{cases}$$

The constants, C_1 and C_2, are such that the smallest possible value of P may $= o$, at the same time that each term between brackets is itself null.

If we wish to have the potential energy of an entire body, we must consider correlatively with the P of each molecule a certain sum, $\Sigma\pi$, of functions of forces, each corresponding to the reciprocal actions between each atom of the molecule in question and all atoms of the surrounding molecules.

Hence we have for this energy—

$$(3) \qquad p = c + \Sigma\, \mathrm{P} - \tfrac{1}{2}\, \Sigma\, \Sigma\, \pi.$$

The constant, c, should be such that when combined with the constants of P it annuls the smallest possible value of p.

VII. The preceding hypotheses and formulæ being well understood, we regard the temperature of each complete molecule of a body as characterised by its actual energy. In the same manner the chemical and the latent thermic and electric state of the molecule is specified as a whole by its total potential energy, P. But in detail its chemical and latent thermic condition appears from the first of the terms between brackets in the expression for P. We call this first term the *ponderable* potential energy of the entire molecule. On the other hand, the electric condition depends on the second of the terms in question. This second term of the expression of P measures the potential energy of the ethereal matter associated with the ponderable matter of the molecule.

Otherwise the physico-chemical modality of the totality of a body is principally specified by the modalities of its several molecules. It is further affected by the respective situations of the molecules for these situations in the term π of the formula (3), and tells principally upon the latent heat of the system.

In the foregoing we have implicitly considered the instantaneous values of the various energies studied. Let us now attend to their successive values. When the successive values attached to each molecule of a body remain constant or oscillate slightly around a fixed mean we say that the physico-chemical modality of the body is permanent. This permanence may be either uniform or not according as there is an equality or inequality of the values in question for all the molecules of the body. The first case requires that the body should be so isolated as to escape the atomic forces of every strange system. The second case is met with when these forces make themselves felt and exert themselves according to a certain correlation. When this correlation is deficient the physico-chemical modality of the body becomes variable. In general the variability affects the modality of each molecule; there is besides a radical modification of this latter modality if chemical phenomena occur.

VIII. In fine, electricity, like heat and light, cannot be regarded as a special agent ruled by an especial mechanics. As a phenomenal cause, it is simply the potential energy of the ether associated with ponderable matter, especially in the form of atmospheres surrounding the molecules. This sort of energy, with which no one hitherto seems to have engaged himself, includes the secret of all electrical effects. Its variations owe their mechanical power to the greatness of $\mathrm{F}\,(l)$, pointed out in VI., which compensates for the common mass, μ, of the atoms of ether. It has, as an appendage, the portion of the potential energy of the ponderable matter which constitutes principally the latent heat, in the same manner as the sensible heat reveals the residual *vis viva* of the ponderable and ethereal atoms, and as the radiant light and heat reside in the vibrations of the free cosmic ether undulating across the celestial spaces or through the molecular interstices of ponderable bodies.

When a body is brought in contact with one or with several other systems so that it feels their influence in one of the manners indicated in VII., a series of modifications of the various energies may ensue, and especially a variation of the ethero-ponderable energy, producing work in the appearance of electricity, including discharges. This last variation may ensue in part from a change in the number of the ethereal atoms constituting the molecular atmospheres, either borrowing from or restoring to the inexhaustible stock which forms the cosmic ether. The said functions are in principle concomitant.

IX. Let us now study the propagation of electricity according to our views. To this end we will first discuss the transmission of heat according to thermodynamics.

There mechanical work is propagated, and there is constantly a difference between place and place in the thermic condition of the body with local permanence if the transmission is regular. In every case the body is merely a simple conductor of energy, and the phenomenon is only effected in virtue of a difference $(\mathrm{A}_2 - \mathrm{A}_1)$ between the actual energies A_2 and A peculiar to each molecule by groups

to the parts of the conductor in contact, the one with a hot and the other with a cold system.

The theory of Fourier associates itself completely to our new interpretation. It is sufficient for this purpose to join to the special hypotheses of this theory the possibility of considering certain differences as infinitely small ones of the first or the second order.

What we have just said concerning the transmission of heat is applicable, word for word, to the propagation of electricity. We need only substitute the consideration of the potential ethero-ponderable energies of successive molecules for the consideration of their actual energies. The electric current consists in a simple transport of mechanical work, w, and the fall of the electric potential corresponds to a difference $(p_2 - p_1)$ between the potential ethero-ponderable energies, p_2 and p_1, proper to each molecule per group in two opposite parts of the conductor.

X. The general mode of the apparent production and transmission of electricity, which we have just indicated, is merely a particular case of a much larger question and which forms an indispensable corrollary of the great law of the conservation of energies. We wish to speak of the transformation and propagation of energies in the most universal case. From the transmission of the work of total movement through the supposed rigid parts of a piece of mechanism we must conceive that this work is propagated only by the intervention of the ponderable potential energies of the said parts, giving rise to phenomena of elasticity.

On the other hand, in the well-known experiment of a series of ivory balls suspended to the same horizontal rod, the *vis viva* of the total movement of the first ball is transmitted to the last, by the aid of the ponderable potential energies of all the intermediate balls. These, as it is known, remain as a whole at rest, and form thus a true conductor of work. There is here a striking analogy with that which takes place according to our theory in the propagation of electricity. It is sufficient to reduce, in thought, the balls to simple molecules with an ethereal atmosphere, and to imagine that the potential ethero-ponderable energies are alone in play.

XI. According to us the only electric magnitude which has a real mechanical signification is the work of the current, w. But, according to III. and IX., we have for $t = \mathrm{t}$, and putting $\omega = \omega_m : \omega_s$—

$$e_s = \sqrt{p_2 - p_1} \times \omega_m i_s = \frac{\sqrt{\mathrm{w}}}{\sqrt{r_s}}$$

$$e_m = \sqrt{p_2 - p_1} \times \omega_m, \; i_m = \frac{\sqrt{\mathrm{w}}}{\sqrt{r_m}}$$

Hence the intensity of the current and the electromotive force of the circuit will be nothing but the roots of certain quantities of mechanical work, multiplied or divided by certain co-efficients.

With these interpretations of the electric magnitudes, i, e, r, we may preserve the greater part of the formulæ already acquired; the experimental establishment and verification of these formulæ merely need to be dealt with according to their true mechanical signification—*Comptes Rendus*, XCV., p. 753.

THE TRANSMISSION OF POWER TO A DISTANCE, AND THE EXPERIMENTS AT MIESBACH-MUNICH.

THE exaggerated figures which have been given by M. Marcel Deprez to estimate the *electric return* in his experiments on the transmission of power between Miesbach and Munich have not been accepted without protestation by a certain number of scientific periodicals; these protestations are produced also in the midst of the Scientific Societies: at the Académie des Sciences, at the Société Française de Physique, by M. Cabanellas (see the ELECTRICAL REVIEW of last week); and at the Society of Telegraph Engineers and of Electricians, by Professor Forbes, at the meeting of the 9th November.

M. Marcel Deprez thought proper to reply to certain objections, and to prevent others, by addressing a letter to *La Lumière Electrique*, a letter inserted *in extenso* in the November 11th number of that journal.

M. Marcel Deprez answers indeed victoriously certain puerile objections, but he leaves completely in shadow and silence those which it was most difficult and, consequently, most necessary to contest and reduce to nothing.

According to M. Marcel Deprez's letter, Professor Kittler would have measured, at his request, the fraction of the current lost along the line before he determined to make this difficult experiment. According to M. Kittler, the intensity of the current being represented by 1 at Miesbach, was still higher than 0·98 at Munich.

Here is an ambiguity which leads to singular mistakes. If the insulation experiments of M. Kittler were made *before* M. Marcel Deprez determined to make the experiment on the transmission of power, how could one conclude from it that the loss upon the line was only two per cent. during the experiment with currents of several thousand volts? This result is the less acceptable as M. Marcel Deprez admits in another part of his letter that it rained almost without interruption for twelve days at the time of the first experiment. The return was measured by taking directly the electromotive force of the machines and the intensity of the current at Miesbach and at Munich; its value is *sensibly* found in agreement with that derived from the relation of the speeds, which shows that the loss of the line was inappreciable. It cannot be too much regretted that M. Marcel Deprez neglected, in his long letter, to give us these interesting figures; it is certain that they would have silenced all discussion, and that they alone would give the true value of the electric return of 60 per cent. so much disputed. By accepting the figures given by the *Bulletin de la Compagnie Internationale des Téléphones*, in which all loss by conductors is ignored, the difference of potential at the terminals of the generator is 2,100 volts and the current 0·5 ampères.

The electric energy furnished by this machine, disposable in the external circuit, is equal to

$$\frac{\mathrm{EI}}{9{\cdot}81} = \frac{2{,}100 \times 0{\cdot}5}{9{\cdot}81} = 107 \text{ kilogrammetres per second.}$$

There may be added to this figure that of the heating of the generator: resistance, 470 ohms; current, 0·5 ampères. Its value in kilogrammetres is—

$$\frac{\mathrm{RI}^2}{9{\cdot}81} = \frac{470 \times 0{\cdot}5^2}{9{\cdot}81} = 12 \text{ kilogrammetres per second.}$$

The generator transforms, therefore, into electricity, a power

equal to $107 + 12 = 119$ kilogrammetres per second.

And as one obtains only 38 at its destination, the return does not exceed

$$\frac{38}{119} = 32 \text{ per cent.}$$

This theoretical inference seems in accordance with one figure given by M. Marcel Deprez, who agrees that the estimated industrial return does not exceed 30 per cent.

We do not know whether the figures given by the *Bulletin de la Compagnie Générale des Téléphones* are correct or not, whether they emanate from the Commission of Experiments, or from interested persons, but whatever be their origin, we should like to be certain as to their value. Ten lines of volts and ampères, very accurately measured, would have assured us better than M. Marcel Deprez's letter of four columns, filled more with assertions than figures. When shall we have the Official Report?

E. HOSPITALIER.

AN ELECTRICAL TRAMWAY.—We notice that experiments have recently been privately made on the Giant's Causeway-Portrush tramway. It is said that several runs were tried of over a mile distance, the speed attained being ten miles an hour. We do not know how many carriages were used, or what weight was carried. The motion is described as being pleasant and without vibration.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

PROVIDING EARTH CONNECTIONS FOR ELECTRIC CURRENTS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Abstract of Published Specifications, 1367, by A. E. Dolbear, in your issue of November 11th. As far as I understand this the claim is for a system of connecting "earth plates" (called here "ground") that has been in constant practice these last ten years. When the railway block system came in force eight to ten years ago, it was the order of the day then to provide a separate "earth" for each block wire. You will readily believe that if more than one block wire was on the same "earth" any accident occurring to it might lead to serious consequences, so it was necessary then in practice to find perfect "earth" for each wire separately. To do this and get "earths" of equal potential it was sometimes necessary to run a wire over a mile in length. But it would now seem that it was left for the inventive masters of this year to apply for letters patent for so common a practice.

As far as telephone companies are concerned I fear the finding of separate "earth" for each wire would be as difficult from a financial point of view as it would be to *insulate* them in *the same water* from an electrical point of view. Query: can it be said of two plates conveying an electric current into the same water that they are insulated from each other by being simply separated? If so what becomes of the theory lately made so much of, viz., signalling through water without the aid of wire.

I may just add that at present I am intimately connected with an "earth" that is not directly in the water nor the sea, on which there are about 400 different telephones connected with wires of all lengths from 100 yards to 25 miles, and working perfectly.

Yours truly,

DENSHIN.

ON INDUCTION.

To the Editors of THE ELECTRICAL REVIEW.

GENTLEMEN,—In your issue for July 22nd, 1882, is given an account of the very interesting results of Mr. Willoughby Smith on "Induction." In some experiments performed last spring regarding the effect of interposed plates of metal on the inductive action between two parallel circuits, I noticed one or two facts which are perhaps worth mentioning in connection with Mr. Smith's results. It appears from the tables given that the "per cent. of inductive energy intercepted," as it is termed, increases with the rapidity of reversal of the current. These results, as shown by the use of the galvanometer, explain an interesting fact noticed when a magneto-telephone is placed in the secondary coil, and a circuit-breaker, as the vibrating reed of an induction coil, in the primary circuit. Under these circumstances the introduction of a plate of metal between the two parallel coils causes, as is well known, a considerable diminution in the intensity of the sound produced; but it is also noticeable that the harsh higher partials of the tone caused by the interrupter disappear far more completely than the lower overtones and the fundamental. The same effect may be noticed with the voice if a microphone transmitter is substituted for the vibrating reed.

I am inclined to think that in the closing paragraph of the article referred to you underrate the value of lead in diminishing induction effects. If a plate of lead is placed between two parallel coils, with a battery and circuit-breaker in one circuit, and a magneto-receiver in the other, there is a very noticeable diminution of sound produced by the lead plate; although this is much less than with sheets of brass or copper, or than when a completely closed spare circuit of copper wire is placed within or between the two coils. Moreover, experiments with an underground cable, constructed by the American Bell Telephone Company for experimental purposes, show that the lead pipe in which it is enclosed exerts a large effect in diminishing induction from wire to wire.

The comparative inefficiency of the tin, or lead-foil covering frequently used to envelope separate and parallel telephone wires, must arise largely from the small mass, and consequent high resistance of the foil. The application of the foil arose at first, I imagine, from the idea that electro-dynamic induction, like ordinary electro-static induction, could be avoided by separating the two circuits by a completely closed wall of any conducting substance, without much reference to its resistance; so that a telephone wire could be entirely protected by the same means used to protect an electrometer from inductive disturbances. But although with a sheet of no resistance this would be the case, it is practically far from true when thin tin-foil is used. With the rapidly-varying telephonic currents, the resistance of the sheet becomes a very important factor, and even a spare circuit wire forms a better "induction shield" than the thin foil coating.

CHAS. R. CROSS.

Massachusetts Institute of Technology, Boston,
October 30th, 1882.

DANGERS OF ELECTRIC LIGHTING.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—So much has been written on the above subject, and such fears have been engendered in the minds of many who otherwise would be glad to adopt a system of electric lighting, that a few remarks tending to allay such fears, may not be deemed unworthy of a space in your valuable journal.

That there is some danger is as undeniable as that equal, if not greater, danger exists in the use of any other illuminant; but I maintain that with the most ordinary care, and under the supervision of a *practical* electrician, the danger attending electric lighting is far less than that attending any other system of lighting, and where danger exists the fault would lie with the engineer.

I have seen many installations in London and in the provinces, and have been surprised at the rough and careless manner in which the wires have been run, and still more surprised to find that the engineer could see no faults in the work nor recognise sources of danger. Herein lies one of the chief sources of danger in electric lighting: the employment of men who have no practical experience of wire running and joint making, &c. An electrical engineer should be a man who, with a good knowledge of electrical science, can not only supervise but who can give such prac-

tical instruction (by personal illustration) to those under him that there can be no chance of careless work.

Given such a man and the danger absolutely ceases to exist.

The public have really nothing to fear; the majority of the accidents that have been brought so prominently before them have been caused by bad workmanship or palpable carelessness consequent on the introduction of a new scheme and a limited knowledge of details. I cannot but think that the many letters which have from time to time appeared on this subject have not been prompted by entirely disinterested motives.

I am confident that electricians will agree that there are few, if any, instances on record of damage done or life lost by electric lighting which cannot be traced to inferior construction, and the public may rest well assured that the various companies are now fully aware of the importance of giving attention to the smallest detail of construction and will take every precaution to guard against the slightest chance of danger to life and property.

Yours faithfully,

YOSHI.

November 20th, 1882.

BERTHOULD, BOREL AND COMPANY'S ELECTRIC CABLES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—With reference to the article on these cables in your issue of the 11th instant, will you permit us (as the sole representatives of the manufacturers in this country) to offer the following remarks.

The manufacturers have introduced considerable changes in their process of late; and their cables widely differ from those you speak of as Mr. Marshall's. Paraffine is now no longer used, but instead a new insulating compound is employed. Further, the lead tube is not first formed, and then the wire drawn into it—as you describe by Marshall's process—but the lead-covering and insulating material are put on simultaneously and automatically.

With regard to time-tests, we can point to the fact that two years ago a large quantity was placed in the marshy borders of the lake at Neufchâtel, and though covered only with a single sheathing of lead, has not deteriorated in the least during all that time, and tests show the insulation to be as perfect now as on the day the cables were laid. So confident are we of the durability of Messrs. Berthould, Borel and Company's cable that we are willing to guarantee it for any reasonable number of years.

Yours faithfully,

J. T. ZORN,

Acting Manager,

The Electrical Trading Company (Limited).

[Our correspondent does not appear to have read carefully our remarks as applied to Mr. Marshall. The Windsor Park experiment referred to in our article proves most conclusively that under certain conditions a lead protecting covering would undoubtedly decay, and we cannot see that there is any peculiarity in the Berthould-Borel cables which could absolutely prevent such deterioration.—EDS. ELEC. REV.]

QUERIES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I should be much obliged if, in the columns of your valuable journal, you could kindly answer the following questions:—

What is the distance between the poles on a G. P. O. telegraph line on which a twisted telephone circuit is arranged? In which book can I fully study the laws which govern the lines of magnetic force and the theory of dynamo-electric machines based on these lines?

In explaining the induction of a conductor traversed by a galvanic current upon a neighbouring closed circuit, most text-books, as far as my knowledge extends, state that in the latter *one* induced current is produced. In order to eliminate induction from a telegraph wire on a telephone circuit, a complete metallic circuit is used, and induction is eliminated by *two* induced currents in the telephone loop which neutralise each other—one current in each wire—being both of the same direction relative to the primary, but of opposite direction relative to each other. How must I explain the production of these currents in accordance with the statements of the text-books? An exposition of these induction currents with special regard to their occurrence in telephone circuits would be very acceptable to your "novice readers." Perhaps you can recommend some book which treats of this question? Yours respectfully,

FRÅGVIS.

Sweden, Kapparberg, *November 17th*, 1882.

[We will endeavour to reply fully to our correspondent's queries in our next issue.—EDS. ELEC. REV.]

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I see by your last issue that you desire to hear the opinions of students on the various courses of electrical engineering which they are attending.

As a student at the City and Guilds of London Institute I beg to say that, in my opinion, the *lectures* are all that could be desired. But as regards the experiments, I am afraid there is much to complain of. In the first place the rooms are too crowded; indeed so much so that I have frequently spent an hour in unsuccessful endeavours to perform an experiment. Secondly, the only assistance the student receives, as a rule, in carrying out the experiments is from the written instructions attached to the instruments, which are ofttimes too vague to be understood by the "beginner." As regards electrical tables and formulæ, as far as I can recollect, no attention has yet been paid to these subjects. No "home lessons" are given to the students to prepare. With reference to your last query, the lectures are very fully illustrated by experiments, but on account of the crowded attendance they are invisible to a large proportion of the students present.

In conclusion I might state that I should be all the more pleased if greater attention was paid to the construction of machines, lamps, &c., as a mere knowledge of the theory can be obtained from any text-book on electric lighting.

I remain, dear Sirs, your faithfully,

F. W. F.

London, *November 21st*, 1882.

ELECTRICAL TRICYCLES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I have read with much interest your article on Messrs. Ayrton and Perry's new electric tricycle, but I have looked in vain to see that any provision has been made to comply with the Locomotives (Roads) Act.

The introduction of foot-treadles would not suffice, as from the description it would appear that the tricycle could travel on level roads without their use, and would therefore be an infringement of the Act as laid down in Parkyns *v.* Priest. I think for the protection of the public that this matter should be thoroughly thrashed out, as the *user* and not the inventor is made the victim of the £10 penalty.

Yours, &c.,

CHANCERY LANE.

TELEPHONE COMPANIES AND OVERHEAD WIRES.—We understand that for some time the local telephone company and the Birmingham Corporation have been in communication as to putting the wires underground, and that very shortly the work of placing telegraph wires below the streets will be begun. The company's representatives say they have always endeavoured to fix their overhead wires so as to enable them to resist any gale of wind which may attack them, but while well assured as to their safety they feel that the time has arrived when an effort should be made to avoid the necessity for extending their overhead system. The fire which recently occurred in Manchester, and damaged the overhead wires, is an argument in favour of the telephone company's desires.

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

FRENCH PHYSICAL SOCIETY.—The first meeting of the French Physical Society, after its vacation in August, September, and October, took place on November 3rd, under the presidency of M. Gernez.

M. Jablochkoff presented two forms of his Ecliptic motor, of which we gave the description in an October number of the ELECTRICAL REVIEW.

M. Berson gave the results of his studies on the influence of temperature upon magnetisation in iron, steel, nickel, and cobalt. He places for this purpose the bar to be tested in a constant magnetic field at various temperatures and compares its magnetic moments by the Gauss method.

His apparatus consists of a Bunsen pile of from six to ten elements, from which the current, after having passed through a commutator, traverses a rheostat of retort carbon and then passes through the bobbin which serves to produce the magnetic field. A galvanometer, inserted in a derivation, allows of keeping this current constant. In the magnetising bobbin is placed the bar, which acts on a small declination needle suspended by a thread of cotton in the interior of a copper cage. The derivations are read by means of a mirror and scale.

The magnetising bobbin, which must bear high temperatures, consists of a coiled wire, the coils of which do not touch each other, upon a glass core embedded in plaster. The whole is placed in a copper stove and heated by a gas-lamp. The temperature, which is kept constant as long as possible, is measured by means of a thermometer which dips into the stove.

The following are some of the results obtained :—

In iron, magnetisation is almost independent of the temperature. However, total and temporary magnetisations increase up to 260°, then decrease, whilst permanent magnetisation diminishes very slightly.

In steel, total magnetisation increases at first, reaches a maximum at 260°, and then decreases; temporary magnetisation follows the same course; permanent magnetisation gives a maximum at about 240°. Variations of temperature during the experiment have an influence upon magnetisation, which increases under these conditions.

If one raises the temperature of a bar magnetised when cold, its magnetisation diminishes; it is the same if one cools a bar magnetised under heat. If it is tempered it preserves a greater magnetic moment than if it had been made at a low temperature.

In nickel, total magnetisation increases slowly up to 240°, and, after 280°, diminishes very rapidly, and disappears entirely at about 330°. Nickel magnetised at a low temperature, and heated to 330°, loses all magnetisation; if, on the contrary, it is magnetised at 280°, and then slowly cooled, its magnetic moment first increases, then diminishes towards the ordinary temperature, but finally remains greater than at the temperature of magnetisation.

Cobalt behaves like steel.

Apropos of this communication, M. Bouty signalises a work by M. Poloni, who has studied the magnetisation of steel at high temperatures and the distribution of magnetism in a heated bar.

ELECTRICAL SCIENCE ABROAD.—A correspondent, writing from Monte Video, says :—"I would call attention to the following paragraph in 'Schwendler's Testing Instructions,' Vol. I., page 181 : 'This difference will be greatest when the resistance of the fault is considerable, *and it is situated much nearer to the distant than to the testing station*, WHICH MAY BE RECOGNISED *by the fact of the distant station being able to* RECEIVE *signals much better than the testing station*.' Although from an *a priori* consideration one might be led to accept this statement as correct, it is nevertheless not borne out by calculation (not even by calculations based on the example he gives on page 184, where

The resistance of the instrument, say,		=	4,757 ohms.
„	whole line	„	= 4,626 „
„	x	„	= 3,998 „
„	y	„	= 625 „
„	fault (z)	„	= 1,002 „)

Nor does it agree with the following extract, from the pen of Prof. Ayrton : 'The station at the *worse insulated end* of the line requires LESS battery power than the station at the other end of the line, in order that the current arriving at both ends may be the same.' My reason for bringing the subject before your notice is that I have been surprised to find the former view prevalent in quarters where I least expected, and where a little calculation would convince of the fallacy.

"The Edison incandescent light has been established at the 'Confiteria del Gas,' in Buenos Ayres, with great success. The American Brush Company have just made an experimental demonstration of their system in the same city, which, judging from the reports I have received, has also proved satisfactory.

"The River Plate Telephone and Electric Light Company have commenced telephonic operations in this city, and, judging from the goodly number of wires leaving their central exchange, must be doing a very fair business, notwithstanding that their charge is somewhat high, viz., 8·00 dols. (eight dollars) per month."

THE MUTUAL UNION TELEGRAPH COMPANY.—From the New York press we cull the following information, which will doubtless prove interesting to those of our readers who in any way follow the course of events affecting the Atlantic cable business of this country. The New York *Evening Post* of the 30th ult. says :—

To guard against the possibility that the present harmonious relations between the Western Union Telegraph Company and the Mutual Union Telegraph Company might be disturbed by some new moves on the part of Mr. Jay-Gould, stockholders of the latter company are now placing in trust, for five years, the voting power of a majority of its stock. The trustees are Mr. George F. Baker, President of the First National Bank; Mr. George William Ballou, banker, of No. 14, Wall Street; and Mr. Asa P. Potter, of the Maverick National Bank of Boston. A well-known trust company will be made the custodian of the stock-voting power.

The New York *Herald* of the 31st ult. also remarks :—

The trust of Messrs. Ballou, Baker, and Potter, will close when the majority of the stock shall have been deposited. The duration of the ring, according to a contract signed, sealed, and delivered, is to be five years. Since Saturday it had completed the needed amount of stock by the purchase of 11,000 shares.

The intelligence of this important operation was received late in Wall Street and was the subject of much speculation, of the mental sort, however. The motive of the combination is said to be to insure the shareholders of the Mutual Union Telegraph against the danger of its falling into the hands of Jay-Gould or the Western Union Telegraph Company. It has been asserted over and over again that such was already the fact. Mr. Gould some time last spring transferred 3,000,000 dols. of the stock to the latter company, and this strengthened the general suspicion that it would eventually absorb the whole property of its rival, as it had that of the Atlantic and Pacific and the American Union. Either the present movement sets at rest this suspicion, or it is simply a plan similar to that of which the sale of the "nickel plate" railroad was the outcome for concentrating the Mutual Union stock in the hands of a few, so that it may more readily be disposed of to its competitor at an exorbitant profit. This theory did not find many supporters last evening among the few speculators who at five o'clock had not yet left the "street." Mr. John G. Moore, the president of the Mutual Union, declared to a *Herald* reporter that the object which had been sought was to maintain the entire independence of the company. It would be conducted as it had been, as a competitor and not as an ally of the Western Union. It had been thus far the most successful enterprise of its kind that had ever been undertaken in this country.

CABLE REPAIRED.—The cable between St. Vincent and St. Lucia is repaired, restoring telegraphic communication with the islands of St. Vincent and Barbadoes. The cable between St. Vincent and Grenada is not yet repaired, and the cable between St. Croix and Trinidad is interrupted. Communication with Grenada, Trinidad, and British Guiana, is in consequence suspended.

"THE DEVELOPMENT OF ELECTRICITY AND THE SOLUTION OF THE PROBLEM OF THE WIRES."—This is the title of a pamphlet by H. R. Meyer, in which he advocates the general adoption of his patent permanent-way for electric conductors. The invention is thus described :—

"It consists of slabs of earthenware, cement, glass, or other suitable material constructed with a series of parallel grooves ; these slabs are laid end to end and the *naked* wires laid in the grooves, asphalt is then poured freely over the slabs and grooves, and the whole effectively insulates the wires. The grooves can be made large or small, and will accommodate indiscriminately large electric light rods or ribbons, or the smallest telephone wires. In order to economise space, tier above tier is laid of these slabs, and to further secure the wires from all possible injury, the whole can be laid in a strong cast-iron channel."

There is no reason why Mr. Meyer should not bring his system forward by any means in his power, although its success is doubtful ; but he should avoid the scientific portion of the subject. He says, in speaking of copper ribbon :—

" There is one other point to be mentioned, viz. : That as electricity appears to travel on the surface of a conductor, the more surface is provided the less friction, or, as it is technically called, ' resistance,' and consequent loss of power takes place. Therefore a ribbon of copper, containing in section the same area of metal as a wire, will be a better conductor because of the larger surface it offers for the current to run on. But a ribbon presents technical difficulties in the insulating, and consequently with india-rubber or hemp, insulation is not practicable with that special section."

It is needless to comment on this paragraph as far as electricians are concerned, but it would have been well if Mr. Meyer had made himself acquainted with the relation of conductivity to sectional area of wires before presenting his pamphlet in a form which betrays the want of knowledge on the subject he advocates. If Mr. Meyer will take a tube of very thin copper, say, $\frac{1}{8}$th of an inch in diameter and of a considerable length, and a solid rod of copper of the same diameter and length, he would find on measuring their respective resistances that the copper tube was considerably higher in resistance than the rod, although it has both an outside and inside surface.

THE ELECTRIC LIGHT IN COAL MINES.—Mr. Ellis Lever has offered to give a premium of £500 to any person who will invent the best portable electric lamp for use in coal mines. Mr. Burt, M.P., and Mr. Crawford, the Secretary of the Miners' National Union, have put themselves in communication with Mr. Lever for the purpose of rendering him their assistance in awarding the premium and in promoting the object he has in view.

DANGERS FROM EXPOSED ELECTRIC LIGHT WIRES.—In our last issue we dealt with the many absurd stories that are floating about as to the dangers from electric light wires, and incidentally mentioned a communication addressed to the *Times* by A. I. C. E., the tone of which almost led us to imagine that theatrical managers had taken the writer into their confidence. The following letter has been sent to a contemporary :—

SIR,—Referring to your article in to-night's paper under the above heading, which is evidently pointed at me, let me inform you that your correspondent evidently knows nothing of my intentions as regards the use of the electric light in my forthcoming pantomime, and should not jump at conclusions and make assertions without previously having ascertained whether there is any truth in his remarks. I am, Sir, yours obediently,

AUGUSTUS HARRIS.

Drury Lane Theatre, *November 18th*.

THE ELECTRIC LIGHT AT DUNDEE. — Speaking of the attempt recently made to light New Commercial Street with the electric light supplied by 5 Brush lamps of 2,000 candle-power each, and placed one hundred yards apart, the local press says that the result of the experiment was somewhat disappointing. "The three lamps furthest from the engine were considerably dimmer than the two next it, and these were only moderately brilliant."

On a second trial one of the local papers states that "two of the lamps did not burn so brilliantly as the others, possibly owing to slightly defective connections, for in both cases the lamps beyond them were much brighter. The effect, though much superior to that produced by gas, is not such as was anticipated."

What a pity it is that these bad connections should be allowed to exist until found out by the representatives of the local press ! This fault seems to be a common one with those responsible for the installations of the Brush system. Is it not possible to engage men conversant with the advantages of good joints, or is the high electromotive force of the Brush dynamo-electric machines deemed sufficient to allow of the passing over of such a *slight* matter as a bad connection ?

ELECTRIC LIGHTING.—The Arbroath Town Council having considered the notifications sent them by several electric lighting companies, refuse concurrence, and remit to their Parliamentary Bill Committee to report on the whole matter, including the question of the Council asking for a Provisional Order.

THE Kilmarnock Town Council, at a special meeting on the matter of electric lighting, agreed by a large majority not to take any action in the way of applying for powers.

IN consideration of the small probability of any electric lighting company applying for powers to light Calverley, the Local Board, at last meeting, decided to take no steps towards applying for powers to supply electricity, and the proceedings of private companies are to be carefully watched.

THE Swan Electric Lighting Company having addressed a circular to the Kirriemuir Town Council, the question of applying for a Provisional Order was discussed at their last meeting. As the price of gas is very high, a committee of the Council was appointed to wait on the gas company for the purpose of obtaining a reduction. If the request is not complied with, the electric light will be adopted.

THE electric light is being fitted up at some of the principal mines in the Furness district. Lamps are placed over the pit heads, and by their light mining can be carried on by night as well as by day. At the Ronhead Mines of Messrs. Kennedy Brothers, the offices, workshops, and stores are illuminated by the electric light.

LEAMINGTON is to ask for a Provisional Order not only to supply electricity for lighting, but for "all available purposes." In their last contract with the gas company the Corporation reserved the right to illuminate three of the main thoroughfares by electricity.

THE Councillors of Peebles, at their last meeting, had a letter read from their brethren of Elgin, to the effect that burghs should be allowed to select any company they preferred in the event of their going in for the electric light. After deliberation it was agreed that the communication should be on the table in the meantime, the Dean of Guild remarking that complaints regarding the high price of gas were numerous.

THE Darlington Town Council, acting on the recommendation of their Gas Committee, are to apply to the Board of Trade for permission to supply electricity for public and private lighting.

IN reply to an inquiry by the Morecambe Local Board, the Gülcher Electric Light Company intimate that they have no intention of applying for an order for lighting their district. The notice calling a special meeting of the board to consider the question of electric lighting has been rescinded.

THE Folkestone Town Council are to apply for powers to introduce the electric light "if they deem it necessary."

A PROVISIONAL Order is to be applied for by Sheffield.

THE Hammond Electric Lighting Company have been commissioned to illuminate the shipbuilding premises of Messrs. Andrew Leslie and Company by electricity.

THE extensive works of Messrs. Wright, Turner & Sons, Pendleton, are being fitted throughout with Edison's incandescent lamps. The *Manchester Guardian*, commenting on the innovation, says :—"A number of the rooms are at present worked under the new light, and there is every opportunity for making comparisons between the new method and the old. Seeing them side by side, one cannot

choose but say that the gas is quite put out of countenance. On the question of cost the answer is satisfactory. The gas bill in a big mill is a considerable item. Messrs. Turner paid something like £400 to the Corporation last year, and the calculations they have made lead them to believe that their electricity bill will be about the same after making allowance for interest on the considerable outlay needed for the apparatus under the new system. They are putting electricity very much on the same footing as gas, placing a light at all points where there was formerly a gas-jet. The wires through the mill are covered with cotton coated with oxide of lead." The yard is lighted with two of Dr. Siemens' arc lamps. A number of millowners are waiting the results of the experiments with the intention of adopting the new light, should it prove successful. The whole of the business premises, including the shipbuilding yard and repairing docks, in connection with the extensive engineering and shipbuilding works carried on at Hebburn by the firm of Messrs. Andrew Leslie & Co., are being lighted by electricity. On Wednesday the start was made with thirty-four Brush lamps of 2,000 candle-power; on Thursday six more lamps were in use, and it is intended to fit up sixteen more, in all, fifty-six lamps. A number of other shipbuilding and engineering firms have adopted "the light of the future," amongst them Messrs. R. and W. Hawthorn & Co., St. Peter's; Messrs. Charles Mitchell & Co., Low Walker; The Palmer Iron and Shipbuilding Company (Limited), Jarrow; Messrs. Readhead & Co., Tynedock; and Messrs. Edwards, South Shields. The tenders of the Hammond Electric Lighting Company have been accepted by all the firms.

THE Stirling Police Commissioners held a special meeting on Monday to consider the propriety of making an application for a Provisional Order. On the recommendation of a committee they decided that no application should be made for authority to supply electricity. The committee were desired to watch over and report any future procedure on the part of the two electric lighting companies who had signified their intention of asking for licences.

THE Salford Town Council has decided that, in the present uncertain condition of electric lighting, it was not desirable to apply to the Board of Trade for a Provisional Order to enable the Corporation to supply electricity within the borough; and it was also resolved to oppose the applications of the different companies who had given notice of their intention to apply for such Provisional Orders.

GREAT FIRE IN MANCHESTER.—A destructive fire took place on the 17th inst., in the warehouse of Messrs. G. Hodgkinson and Sons, makers-up and packers, Manchester, resulting in damage roughly estimated at £30,000, and the serious interruption of telephonic communication. The fire broke out in the top of a seven-storey building, and in a very short time flames issued from all the windows on each side. The fire occurred in the centre of the business part of the city, causing great alarm, and at one time grave fears were entertained for adjoining buildings. The building being near the central telephone office, the roof supported a standard on which nearly one hundred wires were fixed, and these were snapped asunder, the telephone system of the city being thereby disastrously affected. The loss of the Lancashire and Cheshire Telephone Company is estimated at about £200.

THE TELEGRAPH WANTED.—Petitions are being numerously signed for presentation to the Postmaster-General praying for an extension of the telegraph to Durness, Sutherlandshire.

THE UNITED TELEPHONE COMPANY (LIMITED) *v.* ORME AND COMPANY—THE UNITED TELEPHONE COMPANY (LIMITED) *v.* BUTLER—THE UNITED TELEPHONE COMPANY (LIMITED) *v.* HAINES.—These were three actions brought on as short causes, before Mr. Justice Fry, on November 17th, to restrain the infringement of the patents of the plaintiff company for telephonic instruments. The first two actions were to restrain infringements in respect of receivers made according to Bell's patent. The defendant in the third action was also sued in respect of infringements in respect of transmitting instruments made according to Edison's patent. A defect in the patent has been remedied by disclaimer of the claim for the phonograph, and plaintiffs were now suing in respect of infringements subsequent to the disclaimer. Mr. Moulton appeared for the plaintiffs in all the actions; Mr. Williamson appeared for the defendants in the first action, and on their behalf submitted to a judgment, and expressed regret at having been guilty of infringement. In the other two actions judgment was taken by default, injunctions were granted, and inquiries as to damages directed.

TERRESTRIAL CURRENTS.—The week which is fast passing away and the one which preceded it will be memorable for the magnificent displays of aurora borealis witnessed and the extraordinary terrestrial currents felt at home and abroad. Judging from the reports of our private correspondents and from those which appeared in the daily press, there can be but one verdict, that the series of storms recently experienced have not been surpassed, if equalled, for many years. Our remarks may be more acceptable if we divide them into two sections, the first dealing with the auroral displays and the second with the earth currents.

AURORA BOREALIS.—The auroral displays have been so frequent of late that only those of importance have been chronicled. On Monday, the 13th inst., the dwellers in the Islands of Orkney viewed a grand display of the "Northern Lights." The whole sky from west to north-west was illuminated by a continuous arch. From the extremities of this arch streams of light stretched to the zenith, while streaks of light of variegated colours flitted about with rapidity, suddenly disappearing and reappearing, and occasionally forming comet-tail figures. On the evening of the 17th, shortly after darkness set in, their attention was attracted by a very unusual display in the south. The sky all round turned very red, next pink, and then yellow. The streamers instead of going towards the zenith ran along from east to west; their different colours producing very pretty effects. Shortly afterwards the sky to the south became hazy. The weather was extremely cold. The aurora was first observed in Scotland about 6 p.m., in the form of broad bands of red light stretching across the heavens from east to west. The appearance of the western sky was at one time such as to convey the impression that a serious fire was raging in the outskirts of the city. As the red light died away it was followed by strips of light blue and green, these in turn giving place to others of blue in the northern sky. While waves of white light ever and anon flashed from south-east to north-west. The display continued with varying brilliancy far into the following morning. In other parts of the United Kingdom, shortly after 5 o'clock, a beautiful rose pink aurora was seen in the western skies, which in a few minutes extended across the zenith and well into the east, covering fully one-third of the cloudless heavens. As the evening wore on the display continued with varying brilliancy whilst ever and anon columns of light shot up to the zenith from an arch of greenish light, centred with a mass of bluish-green, situated in the north. American telegrams announce the appearance of a magnificent aurora on the same day, which was visible at all points except where clouds obscured it. Cold weather with snow accompanied the storm in many places.

A correspondent writes to a contemporary on the 18th inst. as follows:—"Last night at about five minutes past six o'clock, while observing the aurora borealis in the northern part of the sky, I observed a most luminous mass, shaped somewhat like a torpedo, moving majestically from east to west over a large arc of the heavens, travelling about 160 degrees in about two minutes. The appearance of the mass was similar to the glow produced by the electric current passing through a vacuum. There was no nucleus, and the illumination was perfectly uniform."

The signalman at Tipton, St. John's Station, says he noticed a bright mass of light suddenly appear in the east, and pass swiftly to the west. It was visible from fifty to sixty seconds, and during that time the block and signalling instruments were greatly affected. During the passage of the object, and for some seconds after its disappearance in the west, the block bells were continuously rung.

In connection with the foregoing, M. Flammarion, the Parisian astronomer, received a telegram on Thursday from M. Bruguière, at Marseilles, informing him that there is at

the present moment a quadruple spot on the sun's surface, visible to the naked eye, and of far greater size than the earth. Magnificent aurora borealis is reported from Norway. Strange to say, this is the seventh time this year that the northern lights have made their appearance simultaneously with the presence of enormous spots on the sun's surface.

Mr. J. M. Rodwell, M.A., describing the cluster of spots at present visible on the lower eastern side of the sun's orb, somewhat below the equatorial line, says :—"Phenomena very nearly similar were seen on August 20th, since which time the sun spots have been in a state of constant and active change. Supposing the diameter of the sun to be 882,000 miles, each of these spots must be from 25,000 to 40,000 miles across."

The space at present at our disposal is so limited that we are reluctantly compelled to omit many interesting details, and hasten to "Earth Currents."

EARTH CURRENTS.—A *Times* telegram, dated Philadelphia, November 19th, says :—The electrical storm which began to derange the telegraph wires on Friday last still continues, though with less intensity. It spread through Canada and the greater part of the United States as far west as Utah. The electricians say that the disturbance was unlike anything heretofore known, acting upon the wires in strong waves, which produced constant changes in the polarity of the current.

The *Standard's* New York correspondent, telegraphing on Sunday night, says :—An electric storm, the wildest and severest ever known, has swept from New York West to Omaha and Kansas City, and northwards as far as the telegraph goes. The messages were almost entirely stopped. The successive negative and positive waves of the currents passed from east to west, alternately intensifying and neutralising the battery currents, and the instruments were repeatedly fused (?). At Nashville the galvanometer varied eighty degrees. Bangor worked a message a distance of 700 miles without a battery. At Milwaukie, by means of the storm alone, an electric light requiring eight horse-power was kept burning for some time. Reports from the Continent show that the storm was also experienced there, and that telegraphic communication was rendered almost impossible.

The *Daily News* publishes the following :—At Omaha the aurora borealis was so brilliant that night was made as light as day. At Cheyenne Denver, and at points in California and Washington, there were similar displays. At St. Paul's, Minnesota, the sky was of a blood-red colour, making an effect at once grand and fearful. The telegraphic communication was seriously interrupted and various experiments were tried to work the wires without success, until it was discovered that by taking two wires from the ground between two points and joining their ends a circuit was formed that could be worked. In this way eight wires were made to do the service of four.

While we admit that the storm was of unusual severity, we suspect the imaginative powers of the American correspondents have been largely drawn upon, particularly as to the electric lighting and the *discovery* of the value of a metallic circuit under such disturbing circumstances by the American electricians.

At home earth currents have been more or less prevalent for some time, and during the early part of Friday, the 17th inst., they took joint possession of the wires for a couple of hours, and gave some trouble. About midnight they again showed themselves, but not materially interfering with the workings of the circuits they received scant attention. At 10.25 a.m. on Friday earth currents suddenly appeared on all the lines, and such was their strength that they practically took possession of the entire telegraphic service of the country. On the railway systems the alarm bells were kept ringing, and the needle of the speaking instruments rested on the stop-pins after the dials had described arcs of about 45 degrees.

On the Postal system looping where possible was quickly resorted to with beneficial effect; but where no such arrangement could be made work was seriously impeded, and at times entirely stopped. This state of affairs lasted, with but little variation, for about two and a half hours, when the wires regained their normal condition. All went well until the hands of the clock pointed to 3 p.m., when the currents began to reappear, and continued to increase in intensity as time sped on till midnight, when their strength began to decrease; but they had not entirely disappeared at 4 a.m. next morning, when the principal circuits closed. The maximum force attained is said to have been about 60 volts, one observer says 80. Remarkable features of the perturbations were the rapidity with which the currents changed direction, their celerity in attaining their maximum strength, half a second (?) being the time required in many instances, and the effects produced on the east and west lines, which were greater than on those running north and south.

On Saturday at 10.30 a.m. the lines to the east and west and north and south were interrupted by terrestrial currents of strengths which necessitated the working of metallic circuits. Throughout the day they were more or less troublesome, and Sunday morning was advanced before they vanished *in toto*. Monday morning brought with it a renewal of the storm, and until 5 p.m. the currents were very troublesome. They reached a maximum intensity at noon, and as on the preceding days were variable in directions. In the evening with an auroral display they returned, and made working so difficult that the Post-office authorities had to issue notices of probable delay to all places. On Tuesday there was another renewal of the disturbances, the direction of the currents being from north to south.

SNOWSTORMS.—Last week a heavy snowstorm visited England. At Warwick telegraphic communication was suspended during the morning, and at Kidderminster the telegraph wires were broken by the weight of the snow clinging to them, and fell in one of the main thoroughfares, fortunately, however, without injuring any person.

SCIENCE LECTURES.—On Saturday evening, November 11th, a lecture was delivered to a very crowded audience (many being unable to obtain admission), at the Working Men's College, Great Ormond Street, by Mr. Wm. Lant Carpenter, B.A., B.Sc. (Lond.), on "The Telephone, Microphone, and Photophone." Sir Henry Lefroy, R.A., ex-governor of Tasmania, presided, and in introducing the lecturer, spoke of that gentleman's personal experience of the working of the telephone, &c., in America, Australia, and New Zealand.

Mr. Carpenter commenced with an exposition of the elementary principles of wave motion, and the propagation of sound by it through solid, liquid, and gaseous media. In this connection he reminded the audience of Wheatstone's telephonic concert in 1855 at the Royal Polytechnic, the closing of which he deeply regretted (applause). A drawing of this, illustrating the transmission of musical sounds from the basement to the topmost storey of the building, was projected (as were numerous other photographs) upon the screen. String and other toy telephones depended on the same principle. The telephone of the present day, however, was electrical, and depended on the close relations between electricity and magnetism. The statement that "the transfer of electricity always produces magnetism, and the motion of a magnet always produces electricity," was explained and actually demonstrated by experiments projected on the screen. It was then pointed out that the earliest electrical telephone, that of Reis (1852), transmitted musical *tones* only, and that its action was due to the fact that soft iron emitted a sound when temporarily magnetised. The first electrical transmission of articulate speech was achieved by Alexander Graham Bell in 1876. Mr. Carpenter gave a very interesting sketch of the steps by which his friend, Mr. Bell, was led to a solution of this problem, which grew out of an entirely different line of research, viz., the construction of instruments which should graphically record sounds in such a way as to assist in teaching deaf mutes to speak, and began with Kœnig's manometric capsule and a rotating mirror to analyse the flame-images. The action of Bell's telephone depended on the following principles :—

1. The passage of sound through the air in waves, causing an iron disc to vibrate mechanically.

2. The alteration in the condition of a magnet by any change in its "field" *e.g.*, by the vibration of the iron disc in front of one pole.

3. The excitation of undulatory electric currents in a coil of wire surrounding such a magnetic pole.

Details of the construction of the instrument were given,

as well as of the series of changes involved in its use, both as a transmitter and receiver. The microphone was then explained and its application to the construction of telephonic transmitters, and the lecturer thus led up to the subject of telephone exchanges, upon which he spoke at some length, contrasting their rapid development in America with their slow adoption in this country. The recent rapid extension of their use in New Zealand, as shown in official reports he had just received from there, was commented on, and Mr. Carpenter incidentally recounted a conversation held between Wellington and Napier, 232 miles apart, with ordinary Blake transmitters and Bell receivers, over railway lines near wires conveying battery currents. He also mentioned several other telephonic feats that had occurred within his own personal knowledge, and then passed on to the consideration of the photophone.

As the action of the microphone depends upon alterations in the electric resistance of pieces of carbon by air-waves of sound, so the action of the photophone depends upon the fact that the electric conductivity of (the rare element) selenium, is altered by rays of light falling upon it. Details were given of the construction of the instrument. The transmitter consists of a thin flat mirror reflecting a steady beam of parallel rays of strong light. Speech uttered near the mirror causes it to shake, producing vibrations in the reflected beam also. At the receiving station these beams are collected by a parabolic mirror, and concentrated upon a selenium cell, through which an electric current is passing, a telephone being also included in the circuit. Variations in the beams received from the distant station produce variations in the intensity of the current passing through the cell, and these are converted by the telephone into a series of sounds. Thus articulate speech can be transmitted by variations in a beam of light, without the intervention of any conducting wire, and by these means, using a beam of sunlight, speech had been reproduced at distances measured as yet only by hundreds of yards. In its present stage, therefore, this marvellous instrument was more scientifically interesting than practically useful.

NEW COMPANY REGISTERED.

INCANDESCENT ELECTRIC LIGHTING COMPANY (LIMITED).—Capital £250,000, in £5 shares. Objects: To manufacture and supply electric light and power, and to deal in cables, wires, instruments, and telegraphic and electrical material. Signatories (with 1 share each): R. E. Bell Crompton, Chelmsford; C. W. Torr, Birmingham; H. L. Thomson, Chelmsford; R. H. Milward, Birmingham; F. W. Simms, 47, Holborn Viaduct; F. T. Medcalf, 1, Great George Street, S.W.; Henry Lea, Birmingham. Registered 15th inst., without Articles of Association, by Milward and Co., 41, Waterloo Street, Birmingham.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

SWAN UNITED ELECTRIC LIGHT COMPANY (LIMITED).—The return of this company made up to the 3rd ult., was filed on 15th inst. The nominal capital is £1,000,000, in £5 shares. Upon £80,150 shares, £2 per share has been paid and 10,000 shares are fully paid up. The total calls paid amount to £160,300 and considered as paid to £50,000. Registered office, 9, St. Mildred Court, Poultry.

EDISON ELECTRIC LIGHT COMPANY (LIMITED).—The official return of this company, made up to July 20th, was filed on the 16th inst. The nominal capital is £1,000,000, in £10 shares. 20,000 A shares have been taken and £5 per share called thereon, the calls paid amounting to £100,000. Registered office, 74, Coleman Street.

BRUSH ELECTRIC LIGHT COMPANY OF IRELAND (LIMITED).—The return of this company, made up to the 28th ult., was filed the 20th inst. The nominal capital is £250,000, in £5 shares; but the seven shares taken by the subscribers to the memorandum and articles of association are all at present issued. Registered office, 31, Lombard Street.

ELECTRIC "SUN" LAMP AND POWER COMPANY (LIMITED).—The return of this company, made up to the 7th inst., was filed on the 10th inst. The nominal capital is £200,000, in £5 shares. 7,759 shares have been taken up and a call of £2 10s. per share has been made thereon. The calls paid amount to £20,206 and unpaid to £252. Registered office, St. Margaret's Offices, Victoria Street, Westminster.

NEW PATENTS—1882.

5346. "Incandescent electric lamps." J. JAMESON. Dated November 9.

5353. "Manufacture of carbons for electric lighting." H. C. B. SHALDERS. Dated November 9.

5359. "Means for insulating electric wires." W. J. TEMPLE and T. F. HORNS. Dated November 10.

5373. "Improvements in electric lamps or lighting apparatus, and in the manufacture of light-emitting conductors for the same." J. M. BOULTON, J. PROBERT, and A. W. SOWARD. Dated November 10.

5387. "Apparatus for regulating and controlling electrical currents." P. R. ALLEN. Dated November 11.

5388. "Manufacture of compounds of india-rubber, of gutta-percha, and of oils for insulating electrical conductors, and for other uses." A. PARKES. Dated November 11.

5391. "Improved apparatus for indicating or telegraphing the 'score' for athletic or other games, which apparatus is also applicable as an indicator for other analogous purposes." C. GREEN. Dated November 13.

5400 "Carbons for use in electric lamps and for other purposes." J. E. T. WOODS. Dated November 13.

5409. "Apparatus for electric lighting." J. MUIRHEAD and T. M. COLLET. (Communicated by G. A. Grindle.) Dated November 13.

5414. "Apparatus for regulating and controlling electrical currents." P. R. ALLEN. Dated November 13.

5421. "Thermo-electric generators." H. WOODWARD. Dated November 14.

5422. "Manufacture of electrodes for secondary batteries." H. WOODWARD. Dated November 14.

5438. "Apparatus for the conduction and distribution of electric currents." R. E. B. CROMPTON. Dated November 15.

5492. "Electric light switches." C. MAYNARD. Dated November 18.

5495. "Electric arc lamps." BARON ELPHINSTONE, C. W. VINCENT, and J. COTTRELL. Dated November 18.

5504. "Manufacture of incandescent electric lamps." A. SWAN. Dated November 20.

5518. "Improvements in the distribution of electricity by means of underground conductors, and in conduits and apparatus therefor." C. D. ABEL. (Communicated by L. A. Brasseur.) Dated November 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1583. "Electric bell and battery." H. BINKO. (A communication from abroad by Moritz I. Siegel, of Austria.) Dated April 1. 6d. The inventor arranges the armature to work on pivots, and constructs the same specially by larger bells in two parts, one of which carries the knob and receives his action by means of a lever anchor or claw from the other part, so that a more correct striking is obtained, without vibration, and, notwithstanding the use of a shorter hammer, a much louder tone. The improved electric battery consists simply of a zinc rod or plate, and a cylinder or block formed of a mixture of carbon and manganese, to which is added a proportion of iron filings, oxide of iron or oxidulated copper by means of moulds and pressure, and excited by a solution, as usual, of muriate of soda or salamoniac.

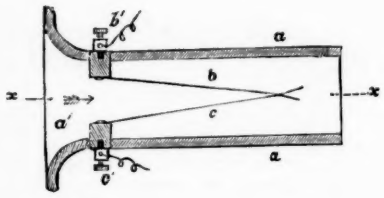
1619. "Carbon conductors for electric lamps." W. R. LAKE. (A communication from abroad by H. S. Maxim, of America.) Dated April 3. 6d. This invention relates to the manufacture of carbon conductors available for use in incandescent electric lamps. Such conductors, as is well known, have a slender thread-like stem, with enlarged clamping ends. As it is desirable that these strips should all be of exactly the same quality and size, it has been usual to cut them by a die from flat sheets of paper or wood in the form of flat strips with widened ends, but when plastic carbonisable compounds are used for making the carbon, it is very difficult to obtain any considerable number of strips of even approximately the same size and resistance by any of the old methods employed, such as moulding and then carbonising, or by cutting out the strips from a hard mass of carbon. This invention is designed to avoid these difficulties in the manufacture of carbon conducting strips of an equal width or diameter from plastic compositions, and consists in a continuous process of forming the said conducting strips, and in the devices employed therein.

1639. "Electro-depositing copper, brass, and bronze." W. H. WALENN. Dated April 4. 4d. Relates more particularly to the improvements set forth in the specifications, filed in pursuance of Letters Patent No. 1540, A.D. 1857, and in No. 3930, A.D. 1868. The first part of the present invention relates to electro-depositing copper upon iron or upon similar metals so that the coating may be soft and adherent. This part of the invention consists in using the solution at a boiling heat or near therto, namely from 150° fahrenheit to the boiling point of the solution. The second part of the invention is to prevent the evaporation of a solution which is heated during deposition. A cover with a long condensing worm tube is

used to the depositing bath. The upper end of the tube opens into a box containing materials to condense or appropriate the gases that escape. The liquids flow back down the tube into the tank. The third part of the invention consists in working electro-depositing solutions in a closed vessel under a known pressure, the pressure being applied by heating the solution, or otherwise. The closed vessel may be used for solutions in which there is free ammonia, or where other conditions arise in which it is necessary to enclose the solution, although neither appreciable increase of pressure arises, nor is heat applied. If there be much gas coming off, the condensing tube opening into a box, of the second part of my improvements, may be employed. The fourth part of the invention consists in adding to the charged and fully made copper, brassing, or bronzing solution, cupric ammonide in the cold until the solution is slightly green.

1663. "Arrangement of circuits, &c., to facilitate communication by telephone." F. D'Artrey Goold. Dated April 5. 6d. Has for its object improvements in the arrangement of circuits and in apparatus to facilitate communication by telephone. The inventor works with closed circuits, and at the "exchange" he provides a switch board to which all the subscribers' wires are brought; they are attached to a series of longitudinal bars of metal, each to each. The bars are insulated from each other, and also from other bars which cross them at right angles and which are for the purpose of coupling, as hereinafter described, any two subscribers who may desire to converse. Also near to, but insulated from, each bar of the series representing the subscribers' wires, there is a piece of metal, and a peg can be inserted between this and the bar. The insertion of the peg completes the circuit through the subscribers' wire and in this circuit a battery at the exchange is included. This is the position when the circuit is not in use. The circuit also includes, at the exchange, an electro-magnetic indicator which, by retaining its armature, shows that the subscriber to whom the indicator appertains does not at this time desire to converse. Whenever a momentary break in the continuity of the circuit occurs the armature falls away from the magnet; such a break takes place when the subscriber removes his telephone from its hook and so at once indication is given to the exchange of his desire to speak.

1684. "Telephonic instruments." A. E. Dolbear. Dated April 6. 6d. Relates to the arrangement of the parts of telephonic transmitters so that the sound or air-waves will so act as to diminish instead of increasing the compression or closeness of contact or approximation of the electrodes (or those portions of the instrument by whose action the vibrations of the air-waves are transmitted to the current) at that phase at which in other instruments there is the greatest compactness, compression or approximation and *vice versâ*. The principle of the said invention is shown in the figure,



which is a longitudinal section; *a* is a short tube containing two tongues or blades, or the electrodes, *b*, *c*, formed of thin metal of a width nearly equal to the diameter of the said tube and extending longitudinally from the wire terminals, b^1, c^1, toward the other end of the said tube. Each of these electrodes, *b*, *c*, is capable of slight movement towards and away from the other, and both are in connection with wires or conductors, b^1, c^1, from any source of electricity. When sound-waves or vibrations enter the tube, *a*, at the mouthpiece or aperture, a^1, they exert their action upon the inner surfaces of the tongues or electrodes, *b*, *c*, and it is obvious that the alternate augmentations and diminutions of density constituting the phases of these air-waves will tend to cause separations and approximations of the electrodes in the same order of succession, as above described.

1689. "Electric lamps." G. S. Young and R. J. Hatton. Dated April 6. 6d. The main object of this invention is to provide a simple and efficient means for automatically regulating the arc or distance between the electrodes in an arc lamp or semi-incandescent lamp. For this purpose the inventors provide the carbon or other electrode or electrodes requiring to be fed with a kind of brake or feed appliance, which is acted on by an electro-magnet or solenoid or equivalent means. This brake consists of one or more chambers or parts, containing each one or more balls or rollers (or it may be a ring in parts or a flexible ring), all so arranged that the balls are made to jamb the electrode (or it may be its holder or part connected therewith) and to move it into the proper position for forming the arc when the said chamber or part is acted on by the electro-magnet or its armature and to retain it in that position until the arc requires adjustment, whereupon the chamber is released by the electro-magnet, the balls being released from the electrode coming against a stop appliance on or connected to the lamp framing. The electrode being thus allowed to be fed the arc is readjusted, the electro-magnet again repeating the action before described.

1692. "Dynamo-electric or magneto-electric machines." T. D. Piot. Dated April 6. 6d. Relates to machines known as dynamo-electric and magneto-electric machines. According to this invention a number of bobbins the cores of which may either be of metal or other suitable substance, covered with copper wire and insulated in the ordinary way, are arranged cylindrically and in radial lines to an axis on which they are mounted and with which they are parallel, thus forming cylinders which constitute the armatures. The said armatures revolve between the interior and exterior of the poles of electro or permanent magnets of horseshoe form. These magnets are placed so that their poles may correspond with the radial lines of bobbins aforesaid. Thus as the armatures revolve each bobbin will be brought successively opposite the poles of the magnets until the whole number arranged on the radial lines are brought in a line with the ends of the poles of the magnets, and as one series of bobbins leaves the magnets the next follows in the same way, and so on.

1713. "Electric arc lamps." J. Brockie. Dated April 11. 6d. In all electric arc lamps hitherto constructed, which regulate by the action of a magnet or solenoid either in a main circuit or in a shunt across the arc or by a combination of both, the regulating armature or core bears a certain and definite mechanical relation to the releasing or feeding mechanism (usually a brake or clutching device) the armature being jointed directly or by levers to the disengaging brake or clutch. The inventor proposes to do away with this definite or direct connection, and to gear the regulating armature to the brake or other device by simple friction, or the friction of magnetism, so that the armature is free to take up various positions in relation to the brake or clutch and yet control it. The play of the brake or its lever is limited between two stops, this play being preferably very small, but the regulating armature or core may have a much longer travel or play; thus it will be seen as above stated, that the armature may take up various positions in relation to the brake lever, the particular position however being determined by the strength of the current; thus no alteration in the tension spring or balance weight acting against the armature is necessary, as the armature will accommodate its position automatically by the current employed. [See page 406 of present issue.]

1726. "Electrical apparatus for signalling on railways." E. Tyer. Dated April 12. 6d. In the specification to letters-patent granted to the inventor on the 1st July, 1881, a method of signalling on railways by means of electric lights is described, and also apparatus for operating according to that method. The present invention consists in improvements in the construction and arrangement of various parts of such apparatus, whereby the inventor is enabled to simplify them and render their action more certain.

1727. "Automatic current director for electric machines." W. Fisher. Dated April 12. 6d. Has for its object an improved device which the inventor calls "an automatic current director for electric machines," which is specially applicable to the machines used for the deposition of metals, such as plating and electrotyping. The device is for the purpose of preventing the current passing in the wrong direction which sometimes takes place as the machines are now used.

1747. "Dynamo-electric machines." D. A. Chertemps and L. Dandeu. Dated April 12. 6d. Consists in a self-exciting dynamo-electric machine, in which the authors have endeavoured to destroy the antagonistic effects of contrary currents which exist in all other machines, causing irregularities in the currents produced. (See Electrical Review, June 10th, 1882.)

1760. "Dynamo or electric current-producing machines." J. B. Rogers. Dated April 13. 6d. The object of this invention is improvements in the construction and arrangement of "dynamo" or electric current-producing machines. For the purposes of the invention the inventor mounts upon a spindle or shaft one or more series of helices or coils and revolves them as one body on one or on both sides of fixed magnetic rings or their equivalent. The rings may be full circles with indentations for an insulating medium to be fitted in, or they may be composed of half rings or segments with an insulating body between the meeting ends or edges for the necessary make-and-break action. The helices or coils may be arranged in single or in double circles to, in, or between supporting or connecting plates, or otherwise arranged to rotate around the face or faces of the fixed ring or rings. By the invention the inventor concentrates the current as generated into the centre of a large magnetic field from which the fluid can be taken direct by conducting wires to lamps for lighting purposes or otherwise!!!!! He dispenses with the usual "commutators" or "Brush" on dynamo machines by the invention and obtains an increased quantity of electric fluid within a given area and of a more highly concentrated nature with less tendency to escape than by the present construction of dynamo machines in which the rings revolve and the coils or helices are fixtures!!!!!

1769. "Secondary batteries." J. H. Johnson. (A communication from abroad by C. A. Faure, of Paris.) Dated April 13. 6d. Refers to the details of construction of secondary batteries in general: A proper vessel to hold the liquid of secondary batteries is an object of great importance which it has been hitherto very difficult to obtain. All such materials as glass and pottery are too brittle and heavy, and not susceptible of being made very large; tanks made of wood must be very expensive, so as to be sound and resisting to change of temperature and moisture, however impregnated with hydrœanaceous substances, while metallic tanks are subject to corrosion, even when covered with any known varnish applied in the heretofore known ways. According to this invention, vessels, tanks and cisterns are constructed in such a manner that they are permanent, cheap and not easily breakable, iron copper or any convenient metal is employed to act as the main body or support of the tank and this is thickly coated on the inside and outside in the following manner. The surfaces of the tank are first coated with a varnish made of pitch linseed oil, paraffine and tar, applied hot, or any such like varnish: then sheets of asbestos, felt or canvas are prepared by soaking them with the varnish, and all the surfaces of the tank are covered with these sheets, put on in a hot state.

1774. "Electrical circuits, &c." A. Muirhead. (A communication from abroad by J. A. Briggs and Kinsman, both of Bombay.)

Dated April 14. 6d. The objects of this invention are :—To obviate the disturbing effects of induction, split currents, earth currents, &c., thus affording certain highly advantageous methods of utilising the same one-trough cable or line of supports for carrying two or more electrical circuits, irrespective of the nature of the said circuits. To increase the carrying capacity of the supports by affording a means of erecting aerial wires close together. (*Provisional only.*)

1803. "Manufacturing incandescent lamps." A. R. Leask. Dated April 15. 6d. The inventor constructs a gauge as follows, though he does not bind himself to the precise materials and forms hereinafter set forth, which merely serve to illustrate the invention. Two tubes, one capable of sliding inside the other, may be used and a block inserted in the free end of each ; each block is pierced with a small hole in the direction of the length of the tubes and binding screws are provided, one to each block and one to fix the sliding tube at the requisite position. There is a suitable stop in the inner tube between which and the block at its end is a helical spring. A slot is formed near the end of the inner tube to permit of the binding screw and block being pushed in, the spring having a tendency to force them out. An ordinary needle or equivalent is inserted in the hole in each block and block and needle secured by the binding screw.

DISCLAIMER.

2038. "Electric-lighting apparatus." Haddan's patent. Gulcher's Disclaimer and Memorandum of Alteration. Filed October 18th, 1882.

CITY NOTES, REPORTS, MEETINGS, &c.

BIRMINGHAM AND WARWICKSHIRE ELECTRIC LIGHT COMPANY (LIMITED).

Last Wednesday afternoon, at the City Terminus Hotel, Cannon Street, under the presidency of Mr. G. M. Felton, an extraordinary general meeting of the shareholders of the above-named company was held, for the purpose of considering certain adverse proceedings which had been taken against the company.

The secretary, Mr. H. W. Atkins, having read the notice convening the meeting,

The Chairman said: Gentlemen, the reason of your being called together to-day is because of the action taken by certain shareholders with regard to this company, which your shareholders believe to be inimical to the interests of the company, and which, if persevered in, would ultimately probably be ruinous. You will remember at the last statutory meeting, held on September 15th, I placed before you a *résumé* of the company's business. We were then in negotiation with several large towns, and we had then, as I told you at the meeting, a contract which would be signed either that day or in a few days, for an instalment of 40 lights. That contract has been signed, and those 40 lights are either now running or will be in a day or two. We were also in negotiation with several large towns with regard to electric lighting, and also with various works to put up electric lights for manufacturing purposes. Unfortunately—or fortunately, whichever you please—the circular by Mr. Whiteley appeared, which said we professed to have what we never had, and about that time appeared a letter in the Electrical Review stating that the Lane-Fox incandescent light had been sold to the British Electric Light Company and then subsequently sold to the Anglo-American Brush Corporation. This came before your directors as a surprise, and we were blamed that we did not take the proper precaution in looking through the agreement. But when our prospectus was issued a copy of it was lodged with our solicitors. They looked it through and submitted it to the Hammond Company ; they looked it through and passed it. It was then submitted to the Anglo-American Brush Company. It was passed by them and returned to us. So that we *bonâ fide* purchased the exclusive right to the Lane-Fox incandescent light, which opinion we still hold and ask you to support us in. At that time Messrs. Ingledew and Ince were our solicitors, and feeling that the feeling of the shareholders would perhaps not go in an amicable direction if the solicitors to the vendee were also the solicitors to the vendor, we placed the matter in the hands of Messrs. Linklater. Upon the very day that Mr. Whiteley's circular appeared, and was sent round to the shareholders, we had a circular printed and the envelopes addressed, calling you together to ask your opinion as to the course we should take in reference to Sir Charles Bright's letter. We submitted our circular to Messrs. Linklater. We were then in negotiation for the re-purchase of the Lane-Fox light ; so we did not send out our circular for a few days, as we hoped in a short time to bring these negotiations to an end and to be able to put before you something tangible, which would put the company in a better position than before. You will bear in mind that since this company was formed an Electric Light Act has been passed—Mr. Chamberlain's Act—which renders the value of an electric lamp much less than before, for now a company cannot insist upon a user taking a certain lamp necessarily. That was not our position when we purchased the Lane-Fox lamp. It is as well to bear that in mind. The legislature has had something to do with that change, whether wisely or unwisely I cannot say (a voice: "Wisely"). When we received Mr. Whiteley's circular we submitted it to Messrs. Linklater, and in that Mr. Whiteley said many things which were decidedly the reverse of complimentary to this company. Mr. Whiteley appears to have a policy of taking very few shares in companies, and sending out a large number of circulars. He holds twenty shares in this company ; twenty in the Yorkshire company, and ten in the Jablockhoff. He sent to the Yorkshire shareholders, two or three days later, the twin brother to the circular this company received. Subsequently the Yorkshire people replied to that. He issued another circular to the Yorkshire company, and they replied to that ; and then he issued one to the shareholders of this company. He says there were very numerous actions lodged against this company. The writ he speaks of was lodged by himself and a gentleman named Sprange.

Mr. Edmonds: There was no other action besides Mr. Whiteley's?

The Chairman: No; not at that time. Mr. Sprange had fifty shares only. Mr. Whiteley, in his circular, says, "I further learn that there are numerous actions pending against the various companies by shareholders who, like myself, have heard the statement in the prospectus, and believe it is false. It is stated further that in some instances shareholders who have brought actions have been paid back in full." Now, gentlemen, in answer to that I may say that not one single penny has been paid out (hear, hear), and not a single penny shall go out of the company so long as I am chairman. Immediately I heard of the action taken by Mr. Whiteley, although we had business in view, I said, "Put that on one side, we have now money at the bank and not one penny shall be laid out in plant until this matter is settled." With reference to the retirement of Mr. Evans and Captain Inman a good deal has been said. With reference to Captain Inman, I may say he only attended our meetings twice, and as he had to come up from Liverpool, he was thereby put to some inconvenience. He gave no reason for resigning. Mr. Evans did give a reason. We were negotiating then for the re-sale of the Lane-Fox. We differed about amounts, and Mr. Evans could not go with us. He consequently resigned, sending a cheque for the money he had had. And nothing could be more straightforward on the part of this gentleman. At that moment I felt that I should like to resign myself, but I also felt I should not be doing my duty to my friends if I did, many of whom took up shares because they thought I should do what was right. You have now every prospect of doing a fair business. Negotiations have been again opened to-day with the vendors, and we have an offer by which they return us very nearly one-third of our capital. Our capital is something like £75,000 or £76,000, and if we have to pay a dividend, surely we can pay a better dividend upon £50,000 than upon £75,000. I ask you to support the directors in these negotiations. I pledge you my word that we will come to no terms unless they are submitted to you, and if you agree with them we will go on with them, and not without. But to want to wind-up the company! I do not know the reason. Perhaps you can guess. (A voice: "Number one." Laughter.) I ask you to support the direction of the company, not only in the interests of yourselves, but in the interests of the shareholders who are absent. When these negotiations are completed you shall each receive a circular, and we shall then have a very fair prospect of good business in front of us.

Mr. Ratcliffe (a member of the board) proposed the first resolution :—"That it is the opinion of this meeting that the recent litigation which has been commenced is most prejudicial to the true interests of the company, and every opposition should be offered to the hostile proceedings against the company." He remarked that the company had been very much hindered by the steps taken by Mr. Whiteley, and of course it was utterly impossible for them to go on until this kind of thing was stopped. His impression was that the matter should be left to the board to arrange and manage. Of course he could not go so far as to say the expectations of those who took shares early would be so fully realised now as they thought they would be, still he believed this would be a fair going company. He had made a great deal of inquiry concerning the Brush dynamo, and he more than ever, perhaps, believed it was a very valuable concession.

Mr. Thomas Beard, C.C., remarked, in seconding the resolution, that he had been told so much about Mr. Whiteley that he thought he was a man whom they should shun. He should venture to designate him as a "wrecker" of companies. He was one of those who took shares in this company, being impressed with the names of the directors. He knew that Mr. Evans did not retire from the directorate in consequence of anything that would reflect upon himself. He was glad to hear the explanation of that event as given by the chairman. He hoped that the shareholders would support the directors. He personally felt confidence in the board, and believed his interests were safe in their hands.

Mr. Hammond said he had pleasure in supporting the resolution. Holding as he did a rather anomalous position as the largest shareholder in this company with his personal money, and with his close connection with the Hammond Company, being in some sense not in the same position as he was as a shareholder, he thought it incumbent on him, as representing the Hammond Company, to deny that his company had passed the prospectus of this company, or their position would not now be so strong as they considered it was to-day. He was sorry to introduce one note of discord into the meeting, but he really must deny that either he or his solicitors passed the prospectus of this company. He agreed with the directors in their policy. He stood up primarily to second the resolution. Still the meeting, he was sure, would think it was quite impossible for him to allow that public statement to pass unchallenged. They held that no liability whatever attached to the Hammond Company in this matter. It was true that the prospectus of this company was submitted through the Hammond Company to Messrs. Renshaw, the solicitors of the Brush Company, but the Hammond Company took up this position, that they sold to this company, word for word, without any addition, that which they received from the Brush Company. If there was any ambiguous language in the agreement, then it goes on to the company granting us the licence. He did not add to or detract from it. He was sure the business of this company should be left in the hands of those who were now directing its affairs, and not in the hands of an outsider who held a few shares.

In answer to a shareholder, the Chairman said, as a matter of explanation, he might say that the solicitor of the Hammond Company was solicitor to this company also.

Mr. David Evans said he rose, in the first place, to support the resolution, but also to state his reason for resigning, which was simply that he was not in accord with his co-directors. When he saw the letter of Sir Chas. Bright in the ELECTRICAL REVIEW, they had Mr. Ince's views upon the subject; and at a board meeting he moved that independent legal opinion be taken with respect to the whole situation. At their next board meeting he moved the following resolution, which he should like, in justice to himself and in justice to the shareholders, to read:—"That the only satisfactory arrangement which can be made with the Hammond company, in consequence of their inability to carry out their contract with this company, is for them to refund to this Company all the cash and shares which have been allotted to them, so as to enable the board to pay the shareholders of this company the full amount paid by them on their shares." Having submitted that to the board, and found it did not accord with the views of his co-directors, he then tendered his resignation. He felt that no compromise should be made. If a mistake had been made by the Hammond Company, he felt that a full claim should be made for the return. He deferred his resignation until the next meeting of the board, in order that the resolution might be shown to Mr. Hammond in the meantime. At the next meeting a letter was read from Mr. Hammond, suggesting a compromise, and saying that there should be a substantial return of shares and cash. But inasmuch as he was acting as the trustee of the shareholders, and representing their interests, he did not agree with his colleagues. They had all acted up to that time in a friendly and business-like manner; and he could speak highly of them. But the matter was one of importance, and he could not agree with them conscientiously. He stuck out for a full return, and he thought the view of the board at that time was in favour of a compromise. He therefore tendered his resignation, which was accepted. He did not think his policy was wild, or unbusiness-like, or inappropriate, inasmuch as after a week or nine days following his resignation he found his co-directors were pursuing the very same mode of attack upon the Hammond Company for the return of the money in which he the previous week had attacked them; and the policy he had advocated three weeks ago was the policy pursued that day.

Mr. Ince said he was sorry to differ from the chairman, who in his statement had said that Messrs. Ingledew and Ince had settled and approved the prospectus of this company. He (Mr. Ince) wished to say that his firm never had settled that prospectus in any shape or form. The prospectus was prepared by the promoters of this company, and his firm had nothing whatever to do with it. Looking at the general position of affairs, he said that on the 10th May the Hammond Company sold to this company a licence to sell and use the Brush dynamo and the Lane-Fox lamp, in the same form of words as the Hammond Company received them from the Brush. The right to use the Lane-Fox lamp was absolutely exclusive, so far as the Anglo-American Brush Corporation and the Hammond Company were concerned. The British Electric Light Company had a similar right to use the Lane-Fox, but not in the district of this company. It was a licence which they had never attempted to use, and was a licence of no value to them, inasmuch as they were not attempting to do any lighting in the district of this company. There had, therefore, been no loss to this company in consequence of the concurrent licence held by the British Electric Light Company. Mr. Ince said what the shareholders would have to decide was whether the statement in the prospectus was a material misstatement; and in the second place, gentlemen would have to swear in court that upon the representation of the exclusive use of the Lane-Fox they were induced to take shares. But, he would ask, how many of them were induced to take shares on that representation?

A Shareholder: Ah, that is your way of looking at it. We don't want to go into these questions to-day. We shall do ourselves much harm if we do.

The Chairman rose to order.

The Solicitor to the company deprecated any cross-questioning, as that would tend to injure the company.

Another Shareholder also questioned the wisdom of Mr. Ince's making any statement.

The Solicitor said: Having regard to the position of the company, and that there was a fair prospect of settlement of this dispute, he would ask Mr. Ince to make no further statement. It was not likely they would agree if they argued, and he could see no good in it. The result of cross-questioning would be to knock on the head certain negotiations which were going on.

The Chairman then put the resolution, which was carried unanimously.

A Shareholder: Is Mr. Whiteley here (laughter)?

Hon. Roger Molyneux then moved "That the chairman having reported to the meeting that negotiations were pending with the various parties interested, with a view to an amicable arrangement of the difficulties with reference to the Lane-Fox licence, be it further resolved that in the opinion of this meeting it is highly desirable that an amicable arrangement of the nature suggested should be come to, with a view to the carrying on of the business of the company, and that the terms of any arrangement should be submitted to the shareholders for their approval before the same is finally concluded." He might add that he was acquainted with those terms, and thought they could have nothing to complain of about them.

Dr. Mackenzie seconded the resolution, and remarked that Mr. Whiteley was legitimately engaged in his business of an auctioneer, selling off a company in the West End (laughter)?

There being no other business before the meeting, the proceedings then closed with a vote of thanks to the chairman, proposed by Mr. Cartwright.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY.—We are informed that the rate for messages, *via* Galveston and the Central and South American and West Coast of America Telegraph Companies lines to Buenos Ayres, has this day been fixed at 16s. 4d. per word, and to all other parts in the Argentine Republic at 16s. 9d. per word.

DIRECT SPANISH TELEGRAPH COMPANY.—This company gives notice of the removal of its general offices to Leadenhall Buildings, Leadenhall Street, E.C.

THE Stock Exchange Committee have appointed settling days in the following securities:—Wednesday, November 29th: Devon and Cornwall Electric Light and Power Company (Limited), shares; Edison's Indian and Colonial Electric Company (Limited), shares; Gülcher Electric Light and Power Company (Limited), shares. The committee have refused a quotation in the shares of the Gülcher Electric Light and Power Company (Limited).

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations. Nov. 22.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	10¼-11	10⅞ ⅛ ¼ ⅞ 10⅞ ⅛ ¼ 11
		Do. Do.	10	20 - 23	
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1 - 1½	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4 - 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	½ - 1	
25,000	5	Great Western Electric Light & Power Co.	2½	½ - 1	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	4¼ - 5½	
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1 - 1	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅜ - ⅝	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1¼ - 1½	
..	..	South African Brush Electric Light & Power Co.	2½	¾ - 1½	
100,000	5	Swan United Electric Light Co., Limited	2	¾ - 2½	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	46½ - 47½	47⅛ ¼
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until }	100	77 - 78	77½
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref. }	100	17 - 18	17⅜
130,000	10	Brazilian Submarine, Limited	10	11¾ - 12	11⅞ ⅝ ½ xd.
16,000	10	Cuba, Limited	10	9½ - 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	7 - 7½	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	16½ ⅝
65,000	20	Direct United States Cable, Limited, 1877	20	11¼ - 11¾	11¾
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10½-10¾	10⅝ ⅝ 10¾
70,000	10	Do. 6 per cent. Preference	10	12¾ - 13¼	13¼
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	103 -106	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11¼ - 11¾	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	108 -111	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	104 -107	105¼
140,000	100	Do. do. registered, repayable 1900	100	103 -106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 -104	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	102 -105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	10 - 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6¾ - 6¾	6¾
163,209	10	Do. 6 per cent. Preference	10	12¾ - 12¾	12¾
125,000	10	Great Northern	10	12¼ - 12¾	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	28 - 29	28¾
100,000	100	Do. 6 per cent. Debentures, 1888	100	100 -103	
17,000	25	Indo-European, Limited	25	30½ - 31½	
38,148	10	London Platino-Brazilian, Limited	10	4 - 4½	4½
12,050	10	Mediterranean Extension, Limited	10	1¾ - 2	
8,200	10	Do. 8 per cent. Preference	10	7¾ - 8½	
9,000	8	Reuter's, Limited	8	12½ - 13	
280,000	Stk.	Submarine	100	245 -255	
58,225	1	Do. Scrip	1	2¾ - 2⅝	
4,200	Cert.	Submarine Cables Trust	100	101 -105	
37,350	12	Telegraph Construction and Maintenance	12	31½ - 32½	32½
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	1	1⅛ - 1⅛	
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	7¼ - 7¾	7½ ¼
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	121 -124	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1¼ - 1⅜	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7¼	
4,669	10	Do. 6 do. 2nd do.	10	5¾ - 6¼	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1 - 1¼	
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	¼	⅛ - ⅛	
100,000	5	United Telephone Co.	5	10¾-11¼	11.10⅞ ⅛ ¼ ⅜ 11 ⅛ 11.11¼ 10¾

TRAFFIC RECEIPTS.

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended the 31st October are £1,617, as compared with £2,098 in the corresponding period of 1881. The estimated receipts for 15th November are £1,540, as compared with £2,129 in the corresponding period in 1881. The July receipts, estimated at £4,921, realised £4,929.

The Western and Brazilian Telegraph Company (Limited). The traffic receipts for the week ending 10th November, 1882, were £2,327, and for the week ending 17th November, 1882, were £2,548, both after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).